

FILE COPY

CONNECTICUT RIVER FLOOD CONTROL PROJECT

HOLYOKE, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

SPECIFICATIONS

**FOR
LOCAL PROTECTION WORKS**

**FISCAL YEAR 1939 SECTION, ITEM H1.2
INCLUDING PUMPING PLANTS - CONTRACT**



WAR DEPARTMENT, CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS

FOR CONSTRUCTION OF

HOLYOKE DIKE

CONNECTICUT RIVER, MASS.

FISCAL YEAR 1939 SECTION

APRIL 20, 1939.

(ISSUED MAY 23, 1939)

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE

PROVIDENCE, R. I.

No. _____ Bidder _____

Invitation No. 699-39-320

(Do not write above this line)

STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS
(Construction Contract)

War Department,
United States Engineer Office,
Providence, R. I.
May 23, 1939.

SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 p. m., Eastern daylight saving time, June 13, 1939, and then publicly opened, for furnishing all plant, labor and materials and performing all work required by the drawings and specifications for the construction of a concrete flood wall, earth dike and appurtenant structures, except as modified by Paragraph 1-11, located on the Connecticut River at Holyoke, Massachusetts.

I. THE WORK shall be in strict accordance with the specifications, bidding schedule and drawings, designated as follows:

Specifications for construction of Holyoke Dike, Connecticut River, Massachusetts, Fiscal Year 1939 Section, April 20, 1939.

The drawings which will become a part of this contract are designated in Paragraph 1-04 of the specifications. Where copies of drawings are requested a deposit of \$10.00 will be required to insure their return. This deposit should be in the form of a United States money order or a certified check, made payable to "The Disbursing Officer, U. S. Engineer Office, Providence, Rhode Island." The \$10.00 deposit for each complete set of drawings will be refunded upon return of said drawings in good condition within 60 days after date of opening bids.

II. GUARANTEE will be required with each bid as follows:
Bid bond, Standard Form No. 24, will be executed in a penal sum approximately equal to and not less than ten (10) per cent of the total amount of the bid. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See Paragraphs 8 to 11 inclusive, of Instructions to Bidders.) Certified check may be furnished in lieu of bid bond.

III. PERFORMANCE AND PAYMENT BONDS will be required from the successful bidder as follows:

a. A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract.

b. If the consideration of the contract will exceed \$2,000.00 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract, when the latter is not more than one million dollars (\$1,000,000.00); forty (40) per cent where the contract exceeds one million dollars (\$1,000,000.00) but is not more than five million dollars (\$5,000,000.00); and two million five hundred thousand dollars (\$2,500,000.00) for all contracts above five million dollars (\$5,000,000.00).

IV. LIQUIDATED DAMAGES for delay will be prescribed. (See Paragraph 1-07 of the specifications.)

V. TAX ADJUSTMENTS. - Provisions for tax adjustments will be made a part of the contract. (See Paragraph 1-12 of the specifications.)

VI. PARTIAL PAYMENTS will be made. (See Article 16 of the contract and Paragraph 1-10 of the specifications.)

VII. ARTICLES ON PATENTS will be made a part of the contract. (See Paragraph 1-17 of the specifications.)

VIII. BID AND CONTRACT. - a. Bids must be submitted upon the Standard Government Form of Bid and the successful bidder will be required to execute the Standard Government Form of Contract for construction. The bid form has an entry for each item on which estimates will be given or payments made, and no other allowances of any kind will be made unless specifically provided for in the specifications or the contract, or adjustments under Article 3 of the contract. A bid for the entire work must have each blank filled.

b. The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder, in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

c. The successful bidder will be required to return the contract duly executed and to furnish the performance and payment bonds hereinbefore described, within ten (10) days after the papers are presented to him.

IX. EXPERIENCE. - a. Each bidder shall state in his bid whether he is now or ever has been engaged on any contract or other work similar to that proposed, giving the year in which it was done and the manner of its execution, and shall submit such other information as will tend to show his ability to prosecute vigorously the work required by these specifications.

b. Each bidder shall submit with his bid a list of the number of persons expected to be employed on the work in each class as contained in Paragraph 1-32 of the specifications, and the number of months they will be employed.

X. COMMENCEMENT AND COMPLETION. - Work shall be commenced within ten (10) calendar days after receipt of notice to proceed and shall be completed within 450 calendar days, in accordance with the provisions of Paragraph 1-07 of the specifications.

XI. MINIMUM WAGE RATES for the locality of the work have been determined by the U. S. Department of Labor, and proof of payment of such wages will be required. (See Articles 17 and 19 of the contract and Paragraph 1-37 of the specifications.)

XII. ARTICLES ON RELIEF LABOR will be made a part of the contract (see Paragraph 1-32 of the specifications).

XIII. EIGHT-HOUR LAW. - The requirements of the Eight-Hour Law, Article 11, of the contract, will be applicable to the work under the contract.

XIV. ARTICLES ON PREFERENCE for domestic materials will be made a part of the contract. (See Article 18 of the contract and Paragraph 1-33 of the specifications.)

XV. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of Paragraph 1-38 of the specifications as a part of the contract.

XVI. INVESTIGATION OF CONDITIONS. - Samples of borings and from test pits taken at the site of the work can be seen at the U. S. Engineer Laboratory at Providence, Rhode Island, where they should be inspected by prospective bidders. Bidders are expected to visit the locality of the work and acquaint themselves with all available information concerning the nature of the materials to be excavated from the borrow or structure excavations, the nature of the materials to be transported and placed in the dike embankments and the local conditions bearing on transportation, handling and storage of materials. They are also expected to make their own estimates of the facilities needed, the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainties of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At bidder's request a representative of the Government will point out the site of the proposed operations. Failure to acquaint himself with all available information concerning

these conditions will not relieve the successful bidder of assuming all responsibilities for estimating the difficulties and costs of successfully performing the completed work.

XVII. FACILITIES AVAILABLE FOR CONSTRUCTION are described in Paragraph 1-06 of the specifications.

XVIII. DATA TO BE SUBMITTED WITH BIDS. - a. Each bidder shall submit with his bid, drawings showing proposed plant layout and charts showing the rate of progress the bidder will maintain on the work, carefully prepared and presented in neat and legible form. These data are considered essential in assisting the contracting officer to determine whether or not the bidder is responsible, experienced in similar types of construction, and that his bid is based on a careful study of construction methods applicable to the work, and with a full realization of the various factors which may affect its progress.

b. The drawings indicating the plant layout shall clearly show the location and manner of employment of the various major items of plant, the method of excavation and disposal of materials, and the manner in which structural features will be erected.

c. The progress charts shall indicate the volume of work to be done and the rate of progress which the bidder agrees to maintain for each of the following major operations required in the performance of the work under these specifications: Excavation, Stool Sheet Piling, Concreting, Earth Embankment, and Rock Fill. These charts may be in any convenient form in which the time element shall be plotted to represent definite intervals of time measured from date of notice to proceed with the work, and the volume of work shall be represented by a suitable scale of percentage of completion based on the estimated contract quantities. Careful consideration shall be given to the preparation of the charts as the contractor will be required to maintain the rate of progress indicated thereon.

XIX. PLANT. - Each bidder shall state in his bid the character and amount of plant that he proposes to employ on the work. After bids are opened any bidder may be required to show that he owns, controls or can procure the plant necessary for commencing, prosecuting, and completing the work as required by the specifications.

XX. AWARD OF CONTRACT. - a. Subject to the rights hereinafter reserved, the work will be awarded as a whole to one bidder. The right is reserved as the interest of the Government may require, to reject any and all bids, and to waive any informality in bids received.

b. A bid may be rejected if the bidder cannot show that he has the necessary capital and experience, and owns, controls or can procure the necessary plant to commence the work at the time proscribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for

the performance of other work which would delay the commencement, prosecution or completion of the work contemplated in this advertisement.

c. Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the United States will be subject to rejection for that reason.

XXI. ADDRESS FOR BIDS. - Bids submitted must be in envelopes with sufficient postage, sealed, marked, and addressed as follows:

(Marked in upper left-hand corner)

Bid for construction of Concrete Flood Wall, Earth Dike and Appurtenant Structures on the Connecticut River at Holyoke, Massachusetts. To be opened 2:00 p. m., Eastern daylight saving time, June 13, 1939.

(Addressed to)

District Engineer
United States Engineer Office,
819 Industrial Trust Bldg.,
Providence, Rhode Island.

NOTE: - See Standard Government Instructions to bidders and copy of the Standard Government Forms of contract, bid bond, payment bond, and performance bond, which may be obtained upon application.

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WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

APPROPRIATIONS: 713022-658/9999-Emergency Relief,
War, Corps of Engineers, Public
Buildings, Parks, Utilities, Flood
Control, etc. (Transfer from WPA),
1938-1939.
21-408/00583 Public Works Adminis-
tration Act of 1938 (Allotment to
War, Flood Control), 1938-1940.

SPECIFICATIONS FOR CONSTRUCTION OF HOLYOKE DIKE

CONNECTICUT RIVER, MASSACHUSETTS

FISCAL YEAR 1939 SECTION, ITEM H1.2

S P E C I F I C A T I O N S

SECTION I. GENERAL PROVISIONS

1-01. Location. - The site of the work covered by these specifica-
tions is located on the west bank of the Connecticut River, in the east
portion of the City of Holyoke, Massachusetts.

1-02. Work to be done. - a. The work provided for herein is author-
ized by the Flood Control Act of June 28, 1938 (Public No. 761, 75th Con-
gress).

b. The work to be done consists of furnishing all plant, la-
bor and materials (except the equipment to be furnished by the Government,
see Paragraph 1-14) and performing all work required for constructing a
concrete flood wall, pumping stations, tailrace structures, stop-log
structures, and short sections of earth dikes, complete in accordance
with these specifications and the drawings forming a part hereof, together
with such other incidental work at the site as may be required for comple-
tion of the work within the intent and scope of the specifications, or
as may be ordered in writing by the contracting officer. It will consist
of the following major items:

(1) Construction of a concrete flood wall between work
line stations 5+89.74 and 59+80.

(2) Construction of 9 concrete tailrace structures.

(3) Construction of 5 stop-log structures.

(4) Construction of 4 pumping stations.

(5) Construction of steel sheet piling cut-off between work line stations 9+70± and 11+280±, stations 17+16± and 19+60±, and stations 19+87± and 60+35.

(6) Construction of an earth dike between concrete structures between work line stations 53+32 and 60+35.

1-03. Description of the work. - a. The flood wall and appurtenant structures including tailrace gate structures will be constructed of reinforced concrete, will be approximately 5,020 feet in length with a sheet pile cut-off, and will have a top elevation averaging approximately 79 feet m.s.l.

b. The pumping stations and appurtenant structures will be constructed of reinforced concrete.

c. The earth dike will be of the rolled earth fill type, about 380 feet long at top elevation approximately 78.5 feet m.s.l., with a maximum height of approximately 12 feet. The land and riverside portions will be of random-pervious material, and the cut-off and core in the middle of the dike will be of selected impervious material. The slopes of the dike will be sodded and seeded as indicated on the drawings. The top of the dike will be covered with a layer of compacted gravel. Crushed stone drains will be installed to provide proper drainage for the landside toe of the dike.

1-04. Drawings. - a. The work shall conform to drawings marked "Holyoke Dike, Fiscal Year 1939 Section" as listed below, which drawings form a part of these specifications and are filed in the United States Engineer Office, Providence, Rhode Island.

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58	Tailrace No. 9 Gate Structure Details	CT-4-1546
59	Tailrace No. 9 Wing Wall Details No. 1	CT-4-1547
60	Tailrace No. 9 Wing Wall Details No. 2	CT-4-1548
61	Tailrace No. 10 General Plan	CT-4-1549
62	Tailrace No. 10 Gate Structure Details No. 1	CT-4-1550
63	Tailrace No. 10 Gate Structure Details No. 2	CT-4-1551

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64	Tailrace No. 10 Wing Wall Details No. 1	CT-4-1552
65	Tailrace No. 10 Wing Wall Details No. 2	CT-4-1553
66	Tailrace No. 10 Pumping Station No. 4	CT-4-1554
67	Tailrace No. 11 General Plan	CT-4-1555
68	Tailrace No. 11 Gate Structure Details	CT-4-1556
69	Tailrace No. 11 Wing Wall Details	CT-4-1557
70	Tailrace No. 12 General Plan	CT-4-1558
71	Tailrace No. 12 Gate Structure Details	CT-4-1559
72	Tailrace No. 12 Wing Wall Details No. 1	CT-4-1560
73	Tailrace No. 12 Wing Wall Details No. 2	CT-4-1561
74	Existing Drains and Pipe Lines	CT-4-1562
75	Drainage Details No. 1	CT-4-1563
76	Drainage Details No. 2	CT-4-1564
77	Drainage Details No. 3	CT-4-1565
78	Drainage Details No. 4	CT-4-1566
79	Drainage Details No. 5	CT-4-1567
80	Miscellaneous Details No. 1	CT-4-1568
81	Miscellaneous Details No. 2	CT-4-1569
82	Steel Sheet Piling Details	CT-4-1570
83	Flood Gate Outlet No. 1	CT-4-1571
84	Flood Gate Outlet No. 4	CT-4-1572
85	Flood Gate Outlets Nos. 6 and 9	CT-4-1573
86	Flood Gate Outlets Nos. 7, 8a and 11	CT-4-1574
87	Flood Gate Outlets Nos. 8b, 10 and 12	CT-4-1575
88	Flood Gate Details and Sections	CT-4-1576
89	Flood Gate Guide Details	CT-4-1577
90	General Arrangement of Gate Hoists	CT-4-1578
91	Flood Gate Hoist Details	CT-4-1579
92	Pumping Station No. 1	CT-4-1580
93	Pumping Station No. 2	CT-4-1581
94	Pumping Station No. 3	CT-4-1582
95	Pumping Station No. 4	CT-4-1583
96	Wall Details - Station 5+89.74 to 11+22.82 Steel Reinforcement	CT-4-1584
97	Wall Details - Station 11+47.15 to A+29.5 Corner Detail - Steel Reinforcement	CT-4-1585
98	Wall Details - Station 20+31 to Station 32+24 Steel Reinforcement	CT-4-1586
99	Wall Details - Typical Sections - Steel Reinforcement	CT-4-1587
100	Wall Details - Typical Sections - Steel Reinforcement	CT-4-1588
101	Tailrace Structure No. 8 - Steel Reinforcement No. 1	CT-4-1589
102	Tailrace Structure No. 8 - Steel Reinforcement No. 2	CT-4-1590
103	Wing Walls - Tailrace Structure No. 8 - Steel Reinforcement No. 1	CT-4-1591
104	Wing Walls - Tailrace Structure No. 8 - Steel Reinforcement No. 2	CT-4-1592
105	Wing Walls - Tailrace Structure No. 8 - Steel Reinforcement No. 3	CT-4-1593

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106	Wing Walls - Tailrace Structure No. 8 - Steel Reinforcement No. 4	CT-4-1594
107	Tailrace Structure No. 10 - Steel Reinforcement No. 1	CT-4-1595
108	Tailrace Structure No. 10 - Steel Reinforcement No. 2	CT-4-1596
109	Tailrace Structure No. 10 - Steel Reinforcement No. 3	CT-4-1597
110	Tailrace Structure No. 10 - Steel Reinforcement No. 4	CT-4-1598
111	Tailrace Structure No. 10 - Steel Reinforcement No. 5	CT-4-1599
112	Tailrace Structure No. 10 - Pump House Steel Reinforcement No. 1	CT-4-1600
113	Tailrace Structure No. 10 - Pump House Steel Reinforcement No. 2	CT-4-1601
114	Wing Walls - Tailrace Structure No. 10 - Steel Reinforcement No. 1	CT-4-1602
115	Wing Walls - Tailrace Structure No. 10 - Steel Reinforcement No. 2	CT-4-1603
116	Wing Walls - Tailrace Structure No. 10 - Steel Reinforcement No. 3	CT-4-1604
117	Wing Walls - Tailrace Structure No. 10 - Steel Reinforcement No. 4	CT-4-1605
118	Tailrace Structure No. 11 - Steel Reinforcement No. 1	CT-4-1606
119	Tailrace Structure No. 11 - Steel Reinforcement No. 2	CT-4-1607
120	Wing Walls - Tailrace Structure No. 11 - Steel Reinforcement No. 1	CT-4-1608
121	Wing Walls - Tailrace Structure No. 11 - Steel Reinforcement No. 2	CT-4-1609
122	Stop-Log Structure No. 1 - Steel Reinforcement	CT-4-1610
123	Stop-Log Structure No. 3 - Steel Reinforcement	CT-4-1611
124	Drainage Structures - Steel Reinforcement No. 1	CT-4-1612

b. The work shall also conform to such other drawings relating thereto as may be exhibited in the office of the contracting officer prior to the opening of proposals and to such drawings used in explanation of details as may be required from time to time during construction, including such minor modifications as the contracting officer may consider necessary on account of conditions discovered during the prosecution of the work.

c. Prior to performing the work, the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Quantities stated in bills of material on Government drawings are approximate only. The contractor shall be responsible for furnishing the required quantity without change in unit price. All items to be furnished at lump sum prices shall be provided by the contractor, complete and in good working order, regardless of whether or not they are fully shown or listed on the contract drawings. Parts and details not fully indicated on the drawings shall be detailed by the contractor in accordance with the best engineering practice, and 4 copies of each drawing shall be submitted to the contracting officer for approval. Each sheet of drawings submitted for

approval shall be provided with a blank white space approximately 5 inches by 4 inches near the lower right-hand corner, just above the title, in which the contracting officer may indicate the action taken. After approval by the contracting officer, but before the work indicated on the contractor's drawings is commenced, one copy of each approved drawing will be furnished the contractor. These approved drawings shall form a part of the contract. The Government will not be responsible for minor errors or minor discrepancies of the contract drawings. Drawings furnished by the contractor for approval by the contracting officer shall be made with ink on tracing cloth. Upon completion of the project, the contracting officer shall be furnished with "Van Dyke" negatives of the contractor's drawings, corrected to show all revisions made during construction.

d. Ten sets of prints of all necessary drawings will be furnished the contractor without charge. Additional prints will be furnished upon request at the cost of printing.

1-05. Quantities. - The following estimate of quantities is given only to serve as a basis for the comparison of bids and for determining the approximate amount of the consideration of the contract. Within the limits of available funds, the contractor shall complete the work specified in Paragraph 1-02 hereof, whether the quantities be more or less than the amounts below estimated.

<u>Item No.</u>	<u>Designation</u>	<u>Unit</u>	<u>Quantity</u>
1	Preparation of Site	acres	5
2	Control and Diversion of Water and Sewage	job	-
3	Support of Railroad Tracks	"	-
4	Common Excavation, General	cu.yds.	59,000
5	Impervious Borrow Excavation	" "	2,200
6	Random Borrow Excavation	" "	1,200
7	Trench Excavation	" "	3,200
8	Rock Excavation	" "	250
9	Sheeting - Timber	M.F.B.M.	100
10	Sheeting - Steel	sq.ft.	16,000
11	Steel Sheet Piling	" "	136,000
12	Impervious Fill, Placing and Rolling	cu.yds.	2,200
13	Random Pervious Fill, Placing and Rolling	" "	2,400
14	Gravel Bedding	" "	2,600
15	Random Backfill	" "	39,000
16	Rock Fill	" "	500
17	Riprap, Hand placed	" "	550
18	Riprap, Grouted	" "	40
19	Rubble Masonry	" "	400
20	Rock for Drains	" "	900
21	8-Inch V.C. Pipe (open joints)	lin.ft.	100
22	10-Inch V.C. Pipe (open joints)	" "	100
23	12-Inch V.C. Pipe (open joints)	" "	1,300
24	15-Inch V.C. Pipe (open joints)	" "	160

<u>Item No.</u>	<u>Designation</u>	<u>Unit</u>	<u>Quantity</u>
25	18-Inch V.C. Pipe		
	a. Open joints	lin.ft.	180
	b. Mortar joints	" "	310
26	24-Inch V.C. Pipe (mortar joints)	" "	200
27	8-Inch V.C. Pipe Perforated (open joints)	" "	50
28	30-Inch Reinforced Concrete Pipe	" "	1,570
29	36-Inch Reinforced Concrete Pipe	" "	140
30	48-Inch Reinforced Concrete Pipe	" "	30
31	8-Inch Cast Iron Pipe (open joints)	" "	220
32	12-Inch Cast Iron Pipe (open joints)	" "	40
33	18-Inch Cast Iron Pipe (open joints)	" "	100
34	18-Inch Cast Iron Pipe (caulked)	" "	36
35	30-Inch Cast Iron Pipe (caulked)	" "	40
36	Cement	bbls.	27,400
37	Concrete, Class "A"	cu.yds.	11,400
38	Concrete, Class "B"	" "	10,450
39	Steel Reinforcement	lbs.	2,320,000
40	Pumping Station Features	job	-
41	Furnishing and Installing Tailrace Gates and Accessories	lbs.	194,000
42	Furnishing and Installing Tailrace Gate Hoists, Complete	pair	16
43	Furnishing and Installing Sluice Gates and Hoists	each	4
44	Furnishing and Installing Traveling Cranes, Including Girders and Side Rails	each	4
45	Miscellaneous Iron and Steel	lbs.	100,000
46	Miscellaneous Black Steel Pipe	"	7,800
47	Copper Water Stops	"	3,700
48	Electric Lighting System (Wiring and Fix- tures)	job	-
49	Fibre Conduit	lin.ft.	6,000
50	Lead Covered Cable (4 sizes)		
	a. 250 M.C.M.	" "	500
	b. 000 A.W.G.	" "	4,000
	c. 0 A.W.G.	" "	2,000
	d. 6 A.W.G.	" "	200
51	Pull Boxes	lbs.	7,800
52	Installing Equipment Furnished by the Government	job	-
53	Installing Miscellaneous Pipe and Fittings	lin.ft.	500
54	Installing Miscellaneous Gate Valves	each	17
55	Timber Stop Logs	M.F.B.M.	16
56	Topsoil on Embankment	cu.yds.	600
57	Sodding and Seeding	acres	0.4
58	Surfacing for Top of Dike	cu.yds.	60
59	Surfacing for Roads	" "	100
60	Bituminous Macadam Road Surfacing	sq.yds.	700

1-06. Physical data. - a. General. - Materials for constructing the earth dike are available in the vicinity of the work. Locations of borrow areas are shown on the drawings. Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and other studies may be seen at the United States Engineer Office, Providence, Rhode Island. It is expressly understood that the Government will not be responsible for any deduction, interpretation, or conclusions made by the contractor from his inspection of the available samples and records. These samples of materials and contract drawings represent all the pertinent information on subsurface exploration which the Government has made at the site. Concrete aggregates will be obtained from approved commercial sources.

b. Plant tailrace data. - The following tabulation gives information on the amounts of water to be taken care of at the various tailraces of the industrial and other plants at the site of the work:

(Tabulation on following page)

Tailrace	Plant	Approximate		Approximate
		Discharge		Discharge
		(Power)	(Industrial)	
		Normal	Maximum	Normal
No. 1	Parsons Div. - A. W. P. Co.	130	170	5
No. 2	Parsons Div. - A. W. P. Co.	60	65	0
No. 4	Holyoke Municipal Plant	0	Not in use	0
No. 5	Holyoke Water Power Company	0	-	0
No. 6	A :Valley Paper Company	425	475	0
	B :	-	-	5
No. 7	A :Crocker Div. - A. W. P. Co.	130	325	0
	B :Crocker Div. - A. W. P. Co.	130	160	0
	C :Crocker Div. - A. W. P. Co.	150	-	8
No. 8	A :Albion Div. - A. W. P. Co.	120	275	0
	B :	170	268	6
No. 9	Mt. Tom Div. - A. W. P. Co.	180	530	4
No. 10	A :Nonotuck Div. - A. W. P. Co.	230	275	4
	B :	0	110	2
No. 11	Gill Div. (Upper) - A. W. P. Co.	190	290	(See note)
No. 12	A :Gill Div. (Lower) - A. W. P. Co.	125	325	0
	:Gill Div. (Lower) - A. W. P. Co.	0	-	6

NOTES:

A. W. P. Co. means American Writing Paper Company.

All discharges are in cubic feet per second.

Total of 6 c.f.s. for industrial purposes for No. 11 and No. 12 usually supplied by No. 12 penstock, but No. 11 would have to supply the 6 c.f.s. when No. 12 is shut down.

Conduit at Tailrace No. 5 to be plugged, except for 24-inch pipe and valve for drainage.

Provision shall be made to handle the normal discharges of water from each tailrace. In giving the information on the tailrace discharges, the Government does not guarantee the accuracy nor assume liability for damages that may result from the use of these data.

c. Transportation facilities. - (1) Railroads. - The New York, New Haven and Hartford and the Boston and Maine Railroads serve the City of Holyoke with main line and branch line traffic. The contractor shall investigate the availability of the sidings from these railroad companies and make all arrangements with them for the use of any sidings for the delivery of any materials and equipment to be used on the work.

(2) Highways. - First-class highways also serve the city. The contractor shall provide for his own construction or access roads and their maintenance. He shall make his own investigation of available roads for transportation, of load limits for bridges and roads, and other road conditions affecting the transportation of materials and equipment to the site of the work.

d. Weather conditions. - The locality is subject to atmospheric temperatures ranging from minus 21 degrees to plus 104 degrees Fahrenheit. The mean annual precipitation at Holyoke is 44.58 inches. The mean monthly precipitation has varied from a low of 3.32 inches in October to a high of 4.34 inches in August.

1-07. Commencement, prosecution, and completion. - a. The contractor will be required to commence the work under the contract within ten (10) calendar days after date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and to complete the entire work within 450 calendar days after said date of receipt of notice to proceed.

b. During the prosecution of the work, the contractor shall conduct his operations in such a manner as not to restrict the discharge from any tailrace an amount less than the normal discharge stated in Paragraph 1-06 for not more than the number of calendar days of the initial and final periods stated in subparagraph c(3) below.

c. Liquidated damages. - (1) General. - In case of failure on the part of the contractor to complete the work within 450 calendar days plus any extensions duly granted under the terms of the contract, the contractor shall pay the Government as liquidated damages for delay in completing the entire work under the contract, the sum of fifty dollars (\$50.00) for each calendar day until all work is completed or accepted.

(2) Gate structures. - In case of failure on the part of the contractor to maintain the discharges from the tailraces in accordance with subparagraph b above, the contractor shall pay the Government, as liquidated damages the rate per day stated in the following tabulation:

for each calendar day of failure to maintain such discharges for each of the tailraces affected in excess of the number of days allowed.

(3) Tabulation.

Tailrace No.	Number of calendar days during which the discharge from the various tail- races may be restricted or shut down.		Liquidated Damages Rate per day
	Initial	Final	
1 and 2	15	8	\$200
4	N o t a p p l i c a b l e		
6	15	8	\$200
7	22	8	\$200
8	15	8	\$100
9	8	8	\$ 75
10	8	8	\$ 75
11	8	8	\$ 75
12	15	8	\$ 75

The contractor shall arrange his construction schedule to include the maximum number of Sundays and holidays during the time the tailrace discharges are restricted or shutdown (see Paragraph 1-15a). The initial period of shutdown of tailraces used for power is for the construction of the diversion works and the execution of necessary work preliminary to permanent construction. The final period of shutdown of such tailraces is for completing final items of work, such as cleaning up and fitting the gates.

1-08. Sundays, holidays, and nights. - No work shall be done on Sundays or on days declared by Congress as holidays for per diem employees of the United States except for the periods necessary to shut down the tailraces and perform emergency work in connection with the gate structures, and in other cases of emergency, and then only with the written consent of the contracting officer. Work may be done at night when authorized in writing by the contracting officer.

1-09. Progress, organization and plant. - a. It is understood that the award of this contract shall not be construed as a warranty by the Government that employees indicated on the organization chart submitted will be sufficient and capable, and that the plant listed in the statement

of the contractor for use on this contract is adequate for the performance of the work, and that the rate of progress as submitted will not be subject to change.

(1) The contractor shall employ an adequate force of properly experienced men capable of supervising and performing the work in a skillful manner.

(2) The contractor shall provide plant and equipment properly adapted to the work and of sufficient capacity and efficiency to do the work in a safe and workmanlike manner. All plant shall be maintained in good working order and provision shall be made for immediate emergency repair. No reduction in the capacity of the plant shall be made except by written permission of the contracting officer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply.

(3) The contractor shall maintain the rate of progress indicated in his bid by the plotted graphs, or a changed rate of progress as agreed upon by the contractor and the contracting officer that may be necessitated by changed circumstances and conditions.

b. Should the contractor fail to maintain the rate of progress proposed in his bid, or the agreed rate of progress (see Paragraph 1-09a(3)), the contracting officer may require that additional men, equipment or plant be placed on the work, or a reorganization of plant layout be effected in order that the work be brought up to schedule and maintained there. Should the contractor refuse or neglect to comply with these requirements to the satisfaction of the contracting officer, the contracting officer will proceed under the provisions of Article 9 of the contract.

1-10. Payments. - Payments will be made monthly in accordance with Article 16 of the contract for work executed and completed as specified or otherwise required, and not included in any prior estimate, subject to the conditions stipulated in these specifications for estimating for partial payments, except that 10 per cent of the amount of each estimate will be retained until the contract work is 50 per cent completed, and thereafter with each monthly payment there will be paid such portion of the amount so retained as in excess of 10 per cent of the estimated cost of completing the work remaining to be done, until the amount retained is reduced to \$25,000, after which the amount to be retained will remain unchanged until the completion of the contract.

1-11. Work covered by contract price. - The contractor shall, under his contract prices, furnish and pay for all material and labor, except the equipment and materials specified in Paragraph 1-14 and Section XIX, and all permanent, temporary, and incidental work, furnish all accessories, and do everything that may be necessary to carry out the work specified in good faith, which contemplates everything specified completed, of good materials with accurate workmanship, skillfully fitted and properly connected and put together.

1-12. Tax adjustments. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipt or other tax (exclusive of taxes on net income or undistributed profits) applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-13. Material to be furnished by the contractor. - The contractor shall furnish all materials and equipment, except as specified in Paragraph 1-14, necessary to complete the work to be done under these specifications. The cost of unloading and loading, handling, hauling, storing and caring for materials furnished by the contractor shall be included in the contract prices for the work to which the materials pertain. All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer, at the expense of the contractor, and no further partial payments will be made thereon.

1-14. Materials and equipment to be furnished by the Government. -
a. The Government will furnish the following materials and equipment for the work under these specifications:

- (1) Pumps with electric motors, piping, valves, and fitting. (See Section XIX.)
- (2) Power switchboards complete. (See Section XIX.)
- (3) Electrical substation equipment. (See Section XIX.)
- (4) Miscellaneous pipe and fittings. (See Paragraph 20-01.)
- (5) Miscellaneous gate valves. (See Paragraph 20-02.)

b. Delivery. - The contractor shall give the contracting officer 30 days' written notice of the quantities, designation, and desired delivery dates of materials and equipment required. The Government will not be liable for any expenses or delay caused the contractor by delayed deliveries, except as provided under Article 9 of the contract. The equipment and materials to be furnished by the Government will be delivered to the contractor f.o.b. railroad cars at Holyoke, Massachusetts, or f.o.b. trucks at the site of the work, at the option of the contracting officer.

c. Unloading and transportation. - The contractor shall promptly unload the materials and equipment from railroad cars and trucks, and will be held responsible for any demurrage charges incurred due to

failure to unload promptly the cars or trucks. The contractor shall transport the materials and equipment from the point of delivery to the site of the work and shall store them in a suitable warehouse until they are incorporated in the work. The cost of unloading, handling, hauling, storage, and caring for the materials and equipment furnished by the Government shall be included in the prices bid for installing the several items of materials and equipment.

d. Shortage. - The contractor shall check the quantity and condition of all materials and equipment when delivered to him and in case there is any damage to, or shortage of, materials or equipment, he shall so report to the contracting officer, in writing, within 24 hours.

1-15. Order of work. - a. General. - The work shall be carried on at such places and also in such order of procedure as may be found necessary by the contracting officer. The contractor shall submit, for the approval of the contracting officer, his proposed program in writing giving the sequence of construction operations contemplated, together with a schedule of shutdown periods for tailrace discharges. In general, the following requirements shall be met, as to relative times for shutdowns of the various tailraces:

(1) Tailraces No. 1 and No. 2. - Both can be shut down at the same time. Neither is to be shut down at the same time as Tailraces No. 7 or No. 12.

(2) Tailrace No. 4. - No relation with other tailraces.

(3) Tailrace No. 6. - No specific relation with other tailraces.

(4) Tailrace No. 7. - Not to be shut down at the same time as Tailraces No. 1 or No. 2.

(5) Tailrace No. 8. - Not to be shut down at the same time as Tailraces No. 11 or No. 12.

(6) Tailraces No. 9 and No. 10. - No specific relation with other tailraces.

(7) Tailraces No. 11 and No. 12. - Not to be shut down at the same time.

b. The periods of shutdowns for the various tailrace discharges shall not exceed that specified in Paragraph 1-07c(3) (see also Paragraph 3-03).

1-16. Damage. - Damage to Government property due to the failure of the contractor to take reasonable precaution, and all loss or deterioration of, or damage to any of the work by flood, accident or exposure prior to final acceptance of the work, shall be made good by the contractor

without expense to the Government; except that the Government will compensate the contractor for repairs to the permanent work, if damaged by flooding or scouring (see Paragraphs 3-02, 7-14c, and 12-01c(2)).

1-17. Patents. - The contractor shall hold and save the Government, its officers, agents, and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented process, or invention, article, or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-18. Grounds and right of way. - a. Grounds and right of way, needed for the work to be done under these specifications, will be furnished by the Government. The Government will not be held liable for any delay in furnishing the grounds or right of way, but in case such delay retards the operations of the contract, the contracting officer will grant an extension of time for the completion of the work equal to the time of the delay (see Paragraph 1-07). The contractor shall have the privilege of using the Government controlled land at the site, not otherwise reserved by the contracting officer; provided, that plans for all construction, storage, or other operations proposed thereon by the contractor are submitted for approval of the contracting officer, prior to the occupation of such areas.

b. The contractor, without expense to the Government, at any time during the progress of the work and when space is needed for other purposes, shall vacate promptly and clean up any part of the grounds allotted to or in use by him, when directed to do so by the contracting officer.

1-19. Removal of rubbish. - The contractor shall keep the site free from rubbish. Suitable spoil areas for receiving refuse from the grounds shall be provided, and the rubbish shall be removed and disposed of as directed by the contracting officer. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with Paragraph 20-08.

1-20. Obstruction and danger lights. - In the contractor's use of streets and highways, for the work to be done under these specifications, he shall conduct his operations so as to cause no greater obstruction to the traveling public than is considered necessary by the contracting officer. The contractor shall provide, erect and maintain effective barricades, danger signals, and signs on all intercepted roads or highways, and on the site where directed by the contracting officer for the protection of the work and safety of the public. All barricades and obstructions which encroach on or are adjacent to public rights of way and all plant connected with the work when directed by the contracting officer shall be provided with lights at night and all such lights shall be kept burning between sunset and sunrise. Such barricades and lights shall conform to the local and State laws. The contractor shall be responsible for all damages resulting from any neglect or failure of these require-

ments. The expense of those and other safety precautions shall be borne by the contractor.

1-21. Inspection and supervision. - a. General. - The work will be conducted under the general direction of the contracting officer, and will be inspected in accordance with Article 6 of the contract, by inspectors appointed by him. The inspectors so appointed will be authorized to reject material or work which in their opinion does not conform to the requirements of the specifications. Any rejected material shall be removed from the site without delay, and any defective work shall be replaced. The contracting officer will furnish on request of the contractor, all location and limit marks reasonably necessary as provided in Paragraph 1-24. The inspectors will keep a record of work done, and see that the location and limit marks are kept in proper order; work done without proper inspection may not be paid for. The presence of an inspector shall not relieve the contractor of his responsibility for the superintendence required in the proper execution of the work (see Article 8 of the contract). Tests to determine the quality and fitness of material used and work done under these specifications will be made as indicated under that part of the specifications pertinent to the particular kind of work, and as stated in Paragraph 1-39.

b. Facilities to be furnished. - (1) The contractor shall furnish promptly, in accordance with Article 6 of the contract, all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the contracting officer and his inspectors.

(2) The contractor shall furnish a room approximately 12 by 20 feet in size, at his concrete mixing plant for a Government laboratory, to be used for making field tests including the moisture content of aggregates and such other field tests as are prescribed in these specifications under Section XI and for temporary storage of concrete specimens. The room shall be protected from the weather, properly lighted, and heated, all of which together with the location and capacity will be subject to the approval of the contracting officer. The contractor shall provide electricity in accordance with Paragraph 1-36.

(3) No separate payment will be made to the contractor for providing these facilities. Should the contractor refuse, neglect, or delay compliance with the requirements concerning facilities for inspection, the specific facilities may be furnished and maintained by the Government, and the cost therefor will be deducted from any amounts due or to become due the contractor.

c. It is hereby understood and agreed that any instructions or decisions by a superior officer through the contracting officer are to be considered instructions or decisions of the contracting officer in all cases under the terms of the contract where decision rests with the contracting officer.

1-22. Interference with traffic on New York, New Haven and Hartford Railroad and support of tracks. - a. Construction of the work near the New York, New Haven and Hartford Railroad shall be conducted in such a manner that there will be no interference with train service. Construction operations during placement of the steel sheet piling and concrete under the tracks, and the placing of concrete and other materials within the right of way area of the railroad, shall be conducted both with respect to time and method as may be required by the railroad.

b. All work and material necessary to support the track during construction shall be provided and paid for by the contractor. A separate agreement will be entered into between the Government and the railroad to provide inspection, the services of necessary flagmen, and expenses incidental to work on track, ties, and ballast, which work will be performed by the railroad at no expense to the contractor (see Section IV).

1-23. Datum and bench marks. - The plane of reference used in these specifications and on the drawings hereof is mean sea level datum. Elevations in feet as specified and as shown on the drawings are to be determined from a bench mark located at the site of the work, the location, description, and elevation (in feet) of which is as follows:

Description of Bench Mark
C-5 at Holyoke

C-5 U.S.C. & G.S. 94.081 feet

At Holyoke, Hampden County, in the southwest corner of the Post Office, and 4 feet above the ground. A U.S.C. & G.S. and State Survey standard disk. (First order adjusted.)

1-24. Lines and grades. - a. The contractor shall keep the contracting officer informed a reasonable time in advance of the time and places at which he intends to do work in order that lines and grades may be given, necessary measurements for record and payment made and progress photographs taken with a minimum of inconvenience to the contracting officer or of delay to the contractor, and the contractor shall have no claim for damages or extension of time on account of delays in the giving of lines and grades or due to destruction of such marks and the consequent necessity for replacement. No direct compensation shall be made for the cost to the contractor for any of the work or delay occasioned by giving lines and grades or making other necessary measurements or by inspection, but compensation shall be considered as having been included in the contract prices.

b. All lines and grades will be given by the Government inspectors as authorized representatives of the contracting officer, but the contractor shall provide at his own expense such temporary structures and such materials and give such assistance as may be required by the

contracting officer and the marks given shall be carefully preserved. After lines, elevations, and grades for any part of the work have been given by the contracting officer, the contractor will be held responsible for the proper execution of the work to such lines, elevations, and grades, and all stakes or other marks given shall be preserved by the contractor until they are authorized to be removed by the contracting officer. The contracting officer may require the work to be suspended when for any reason such marks cannot be properly followed.

1-25. Interpretation of specifications. - The contracting officer shall decide all questions which may arise as to the performance, quantity, quality, acceptability, fitness, and rate of progress of the several kinds of work to be done or materials to be furnished under this contract. He shall decide all questions which may arise as to the interpretation of the specifications and of drawings used and as to the fulfillment of this contract on the part of the contractor, and as to defects in the contractor's work. His determination and decision shall be final, subject to appeal as provided for in Article 15 of the contract.

1-26. Borrow areas. - Borrow areas will be furnished by the local interests without cost to the contractor, including rights of way for transportation purposes across property not owned. If sufficient material is not available in the borrow areas indicated on the drawings or otherwise provided to complete the work, additional areas will be furnished without cost to the contractor.

1-27. Water supply. - The contractor shall provide, at convenient points, ample supplies of water of proper quality for all the operations required under this contract.

1-28. Use of explosives. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety; in accordance with the specifications issued by the United States Bureau of Mines; and in compliance with the local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner, and in accordance with local and State laws; all vehicles and such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES," and shall be in care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-29. Standard stock products. - All material, supplies and articles furnished shall, wherever so specified and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will

be accepted if, in the opinion of the contracting officer, they are equal in strength, durability, usefulness and convenience for the purpose intended. (See Article 7 of the contract.) Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor.

1-30. Safety requirements. - a. The contractor shall make all necessary provisions to protect the public safety, and to maintain and protect existing structures of whatever kind, and shall repair all damages done to such structures. He shall give ample notification to the proper officials of any city or town and of any public utility or other corporation and in particular to the New York, New Haven and Hartford Railroad Company before entering upon their respective public ways or rights of way to perform the required work of construction. Such construction shall conform to the customary regulations and requirements of said officials or corporations. The contractor shall give all notices, take out all permits, and pay all such charges, fees, water and other rates that may be necessary in the carrying out of the work.

b. The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal and State laws under which he is operating, including those concerning the inspection of boilers and other equipment, the licensing of engineers, welders and other employees.

c. The contractor shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable State or local safety and sanitary laws, regulations and ordinances.

d. The contracting officer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include:

(1) The provision of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work.

(2) Adequate first aid and life-saving equipment.

(3) Adequate illumination during night operations.

(4) Instruction in accident prevention to reach all employees.

(5) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang-planks, and other safety devices, equipment and apparel as are necessary to prevent accidents or injuries.

(6) The contractor shall provide watchmen and flagmen for the protection of his own forces adjacent to or within the railroad right of way.

e. The contractor shall promptly report to the contracting officer in form prescribed by him all accidents occurring at the site of the work.

f. The contracting officer will notify the contractor in writing of any non-compliance with the foregoing provisions and the corrective action to be taken. If the contractor fails or refuses to comply promptly the contracting officer may issue a stop order suspending all or any part of the work. Such stop order will be sent by registered mail to the contractor at the site of the work and shall be accepted by him as sufficient notice thereof. Work shall thereupon be suspended as directed. When satisfactory corrective action is taken, a resumption order will be issued. No part of the time lost due to any such stop order shall be made the subject of a claim for extension of time or for excess costs or damages by the contractor.

1-31. Access to work. - The contracting officer, his authorized representative and other duly authorized agents and employees of the Government may at all times enter upon the work and premises used by the contractor, or into his works, or shops. The contractor shall provide safe and proper facilities for such entrance and for the inspection of materials and workmanship.

1-32. Special wage and labor provisions pertaining to persons employed under the provisions of the Emergency Relief Appropriation Act of 1938. - a. Employment of Relief Labor. - The contractor shall plan his work, and the use of machinery and equipment thereon, so as to provide the maximum employment of relief labor. Relief labor shall be employed as uniformly through the contract period as the status of the work will permit, in the opinion of the contracting officer. Except with the specific authorization of the Federal Works Progress Administrator or his representative, at least 95 per cent of the workers paid from Emergency Relief funds shall be referred for assignment to the work by such public relief agency as may be designated by the Federal Works Progress Administrator or his representative.

b. Labor preferences. - (1) Preference for employment shall be given to persons certified as in need of relief by the public relief agency approved by the Works Progress Administration.

(2) No such person under the age of eighteen (18) years, nor one whose age or physical condition is such as to make his employment dangerous to his health or safety, or the health and safety of others, may

be employed under these funds. This paragraph shall not be construed to operate against the employment of physically handicapped persons, otherwise employable, where such persons may be safely assigned to work which they can ably perform.

(3) Only one such member of a family group may be employed under those funds, except as specifically authorized by the Works Progress Administration.

(4) No alien is eligible for employment under the W.P.A. program, even though he may have declared his intentions to become a citizen of the United States.

(5) From among those persons certified as in need of relief who are qualified by training, experience and ability, preference in employment shall be given in the following order:

1. Veterans of the World War and the Spanish-American War and veterans of any campaign or expedition in which the United States has been engaged (as determined on the basis of the laws administered by the Veterans' Administration) who are in need and are American citizens.

2. Other American citizens, Indians and other persons owing allegiance to the United States who are in need.

(6) Except as specifically provided above, such workers who are qualified by training and experience and certified for work on the project by such agency as may be designated by the Federal Administrator of the Works Progress Administration, shall not be discriminated against on any grounds whatsoever.

(7) The contractor shall maintain an up-to-date roster of all employees engaged on the project, showing their names, legal residences, and source of employment.

c. Wages and monthly earnings. - (1) The contractor and all subcontractors shall pay all such employees directly employed on this work at the site thereof an hourly rate of pay which shall not be less than the minimum hourly rate of pay as specified in Paragraph 1-37. "The site of the work" as used in these specifications shall include all operations under this contract or any subcontract, involving labor and materials or labor only, regardless of location, except that operations that are part of the usual and current business of the executor and mingled with other similar work not under this contract shall not be so included. For example, the work of supplying sand and gravel from a pit that is opened up and manned solely for work under this contract is an operation directly on the work.

(2) At least 95 per cent of such employees shall be paid in accordance with the Schedule of Monthly Earnings established by Executive Order No. 7046, dated May 20, 1935, or subsequent revisions thereof,

except with the specific authorization of the Federal Works Progress Administrator or his designated representative (see subparagraph (5)).

(3) A clearly legible statement of all wage rates to be paid the several classes of such labor employed on the work shall be posted in a prominent and easily accessible place at the site of the work, and the contractor shall keep a true and accurate record of the hours worked by and the wages paid to each such employee and shall furnish the contracting officer with a sworn statement thereof on demand. All such employees shall be paid in full not less often than once each week and in lawful money of the United States in the full amount accrued to each individual at the time of closing of the payroll, which shall be at the latest date practicable prior to the date of payment, and there shall be no deductions or rebates on account of goods purchased, rent, or other obligations, but such obligations shall be subject to collection only by legal process.

(4) Wages for any such employees to be paid by, or for which reimbursement is to be made by, the Federal Government may not be pledged or assigned, and any purported pledge or assignment shall be null and void.

(5) The following Schedule of Monthly Earnings is applicable to relief work under this contract (subject to authorized revisions and modifications):

(Schedule of Monthly Earnings on following page)

SCHEDULE OF MONTHLY EARNINGS

<u>Designation</u>	<u>Hours to be Worked Monthly</u>	<u>Maximum Monthly Earnings</u>
Air Tool Operator (Jack Hammer)	119	\$ 71.40
Blacksmith	77	92.40
Blaster (headman)	93	93.00
Brickmason	62	93.00
Carpenter	74	92.50
Electrician (outside)	74	92.50
Fireman	95	71.25
Hod Carrier (Mason Tender)	79	71.10
Laborer (unskilled)	106	60.42
Mechanic (Repairman)	103	92.70
Oiler	*	*
Powder Monkey	*	*
Operator of Large Power Equipment:		
Crane and Derrick	62	93.00
Dragline	62	93.00
Shovel	62	93.00
Operator of Small Power Equipment:		
Compressor (under 400 cu. ft.)	95	71.25
Compressor (400 cu. ft. or over)	95	71.25
Concrete Mixer (under 5-bag)	95	71.25
Concrete Mixer (5-bag or over)	74	92.50
Pump	95	71.25
Tractor (40 horsepower and over)	71	71.00
Truck (1-1/2 tons and under)	106	60.42
Truck (over 1-1/2 tons)	121	60.50
Reinforcing Rod Placer	*	*
Ironworker, Structural	68	93.50

*To be supplied by an Addendum later, if the information becomes available.

(6) The normal hours of work for certified employees shall be that number of hours required to earn the authorized monthly wage at the established rate of pay.

d. Delays - Damages. - Any deficiency in the supply of suitably qualified labor to be referred to the work by such agency as may be designated by the Federal Works Progress Administrator may constitute a basis for demand for the modification of this contract as provided in Article 9 as being an "Act of the Government."

e. Compensation insurance. - The contractor shall provide adequate workmen's compensation insurance for all such labor that may come within the protection of such laws and shall provide, where practicable, employers' general liability insurance for the benefits of his employees not protected by such compensation laws, and proof of such insurance satisfactory to the contracting officer shall be given.

f. Dismissal of employees. - Every employer of such persons may dismiss any such employees only with the approval of the contracting officer.

g. Copies of payrolls. - The contractor shall furnish the contracting officer's representative on the work certified legible copies of payrolls, not later than the third day following the payment of wages, for all persons employed by the contractor and each subcontractor at the site of the work as follows:

(1) Two copies of payrolls for all persons assigned through the Works Progress Administration on forms prescribed by the Works Progress Administration. These forms will be supplied by the contracting officer.

(2) Two copies of payrolls for all other employees at the site of the work. These rolls may be prepared on forms regularly in use by the contractor and subcontractors.

h. Subcontractors. - The contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work for which payment is to be made from funds appropriated by the Emergency Relief Appropriation Act of 1938 to insure the fulfillment of all the provisions contained herein applicable to such funds.

1-33. Purchase of supplies and materials. - a. Preference for domestic articles. - (1) Because the materials listed below or the materials from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin:

Platinum	Rubber	Balsa wood
Chromium	Teakwood	English ball clay
Cork	Sisal	English china clay
Jute	Silk	Natural copper-nickel
Kauri gum	Tin	alloy (monel metal)
Lac	Asbestos	
Nickel	China wood oil (tung oil)	

(2) Articles, materials, or supplies, manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified, because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be in the United States.

b. Purchasing procedure. - Two copies of all purchase orders showing firm names and addresses, and of all shipping bills or memoranda

of shipments received showing car initials and numbers, when shipped by railroad, shall be furnished promptly to the contracting officer. Such orders, shipping bills or memoranda shall clearly indicate weights, and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-34. Minor modifications. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes.

1-35. Protests and appeals. - The Chief of Engineers has been designated by the Secretary of War as his duly authorized representative to make final decision, and to take other action where the terms of the contract require that such decision or action shall rest with "the head of the department concerned or his duly authorized representative." If the contractor considers any work required of him to be outside the requirements of the contract, or if he considers unfair any action or ruling of the inspectors or contracting officer, he shall ask for written instruction or decision from the contracting officer immediately. Any protest based upon such instruction or decision, or claim otherwise arising under the contract, including a request for extension of time under Article 9 of the contract, shall be submitted to the contracting officer within the period specified in the contract. If the contractor is not satisfied with the ruling of the contracting officer, he may, where appeal is stipulated in the contract, make written appeal to the Chief of Engineers. Such appeal containing all the facts and circumstances upon which the contractor bases his claim for relief, shall be addressed to the Chief of Engineers, United States Army, and presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-36. Electric power to be furnished by the contractor. - The contractor shall make arrangements for, shall pay for, and furnish all necessary power to carry on the work, including sufficient power for lighting and other miscellaneous uses in buildings furnished by the contractor for Government use (see Paragraph 1-21b). No separate payment will be made to the contractor for the power furnished.

1-37. Rate of wages. - a. In accordance with Article 17 of the contract, the minimum wages shown in the following schedule, as approved by the United States Department of Labor, shall be the minimum rates of wages to be paid by the contractor for work under this contract. Corresponding rates for occupations not listed below will be furnished upon application by the contractor.

(Schedule of Wage Rates on following page)

DesignationWage Rate - Hourly

Air Tool Operator (Jack Hammer)	\$.60
Blacksmith	1.20
Blaster (Headman)	1.00
Brickmason	1.625
Carpenter	1.25
Electrician (outside)	1.375
Fireman	.75
Hod Carrier (Mason Tender)	1.00
Laborer (unskilled)	.56
Mechanic (Repairman)	1.00
Oiler	.75
Powder Monkey	.60
Operators of Large Power Equipment:	
Crane and derrick	1.50
Dragline	1.50
Shovel	1.50
Operators of Small Power Equipment:	
Compressor (under 400 cu. ft.)	.75
Compressor (400 cu. ft. or over)	.875
Concrete Mixer (under 5-bag)	.75
Concrete Mixer (5-bag or over)	1.25
Pump	.75
Tractor	.75
Truck (1-1/2 tons and under)	.625
Truck (over 1-1/2 tons)	.65
Reinforcing Rod Placer	1.125
Ironworker, Structural	1.375

b. Any class of laborers and mechanics not listed above, which will be employed on the work, will be classified or reclassified by the contracting officer to conform to the foregoing schedule. In the event of disagreement between the contracting officer and the contractor as to such classification or reclassification, the question, accompanied by the recommendation of the contracting officer, will be referred to the United States Department of Labor for final determination.

c. The above list of wages shall be posted by the contractor in a conspicuous place on the work.

1-38. Reports to Department of Labor. - The contractor shall report monthly, and shall cause all subcontractors to report in like manner, within 5 days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective payrolls, the aggregate amount of such payrolls, the man-hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project.

1-39. Standard tests, qualities and guarantees. - a. All materials, supplies and parts and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified, or otherwise required, in conformity with the best modern approved methods for the particular type and class of work.

b. Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the contracting officer by the contractor.

c. Costs of all tests and trials, excepting the expense of the Government inspector and cement, concrete aggregate and cylinder tests, and tests on embankment materials, shall be borne by the contractor and shall be included in the contract price (see Paragraph 11-11).

d. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture, new and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

1-40. Protection of existing structures. - During construction operations, on work covered by these specifications, the contractor shall protect all existing structures and accepted work. Any disturbances or damage to any structures caused by operations under these specifications shall be repaired promptly by the contractor without cost to the Government.

1-41. Final acceptance and payment. - As soon as practicable after the completion of the entire work the contracting officer will make a thorough examination of same and if it is found to comply fully with the requirements of the specifications, it will be accepted, and final payment will be made in accordance with Article 16 of the contract.

1-42. Approval. - This contract will be subject to the written approval of the Division Engineer, North Atlantic Division, and shall not be binding until so approved.

SECTION II. PREPARATION OF SITE (Item 1).

2-01. Work included. - Clearing, grubbing, and disposal of materials shall be done as directed by the contracting officer, within the limits shown on the drawings.

2-02. Clearing. - a. Clearing shall include all necessary portions of the following areas: (1) The area within the limits of the foundation of the required earth dike, together with a 5-foot strip measured horizontally beyond and contiguous to the toe line on each side of the dike, (2) borrow areas, (3) the areas within the working limits of the foundation of the required concrete flood wall or other proposed structure, and (4) portions of the river bank or any other area designated by the contracting officer within the limits shown on the drawings.

b. Trees and other obstructions shall be removed by the contractor from the sites of the proposed structures and of the borrow areas when and as directed by the contracting officer and may be removed from other areas only to the extent directed or permitted. The contractor shall preserve and protect from injury all trees not required to be removed.

c. All timber, undergrowth, brush, logs, weeds, and debris of any nature shall be cleared and removed from the site of the work as directed by the contracting officer.

2-03. Grubbing. - a. The areas to be grubbed shall include those portions of the areas previously cleared as may be directed by the contracting officer.

b. All such areas shall be thoroughly grubbed of all stumps, roots, buried logs, and other objectionable matter. Tap roots and other projections over 1-1/2 inches in diameter within the limits of the wall and dike shall be grubbed out to a depth at least 3 feet below the ground surface, unless otherwise directed by the contracting officer.

2-04. Removal of structures. - The removal of existing structures and utilities required to permit the orderly prosecution of the work covered by these specifications will be accomplished by local agencies except as provided for under Section IV or unless otherwise shown on the drawings. Local agencies will remove and relocate the 6-inch steam line, will relocate the gas mains and the several water lines at or near Wasteway No. 2, and will remove and relocate power lines affected by the work insofar as possible for the convenience of the contractor. The railroad will make all necessary track changes (see Section IV). The contractor will be required to support structures and pipes that are to remain in place or to be placed within the area of the wall and the excavation.

2-05. Disposal of materials. - All materials removed, as specified above, shall be disposed of by burning or by removal to approved disposal

areas as directed. No material shall be thrown into, or left along the bank of, the river. The disposal of material shall closely follow the operations of clearing and grubbing so that brush and other debris will not be washed into the river in case of high water. At no time shall material be placed on land adjacent to the construction area. No damage of any nature shall be inflicted upon adjoining property owners by unwarranted entry or disposal of material on adjacent property.

2-06. Measurement and payment. - The quantity to be paid for under Item 1 will be the number of acres cleared and grubbed. Payment for all work in connection with the preparation of the site as above specified, including the loading, hauling, and disposal of the materials, will be made at the contract unit price for Item 1, "Preparation of Site."

SECTION III. CONTROL AND DIVERSION OF WATER AND SEWAGE (Item 2).

3-01. Work included. - a. The contractor shall protect the permanent construction during necessary unwatering and divert the water from the tailrace conduit outlets, sewer outfalls and at other locations as required by the work. The contractor shall construct all permanent work in areas free from water unless otherwise authorized by the contracting officer. Necessary shoring, sheeting and pumping shall be provided (see Paragraphs 5-01 and 5-08).

b. The contractor shall maintain existing operating sewers, wasteways, and tailraces during construction so that their discharges are unimpeded, and shall divert the water and sewage away from the permanent construction by flumes or otherwise as directed by the contracting officer except during periods of shutdown authorized by the contracting officer (see Paragraph 1-07). The permanent construction work shall be done with minimum of interference to existing manufacturing operations at the site. The contractor shall be required to obtain permission from the contracting officer at least 10 days in advance of any date proposed for shutting off the discharge from any tailrace.

3-02. Cofferdam protection. - a. Any suitable type of cofferdam may be used, subject to the approval of the contracting officer. The cofferdams shall be located so as to provide adequate clearances around the permanent work, and shall be built to such height and section as may be deemed adequate to protect the permanent work. The contractor shall be responsible for the adequacy of the cofferdam protection, and for any damage resulting from failure or washing out of cofferdams, except as specified in Paragraph b below. Subject to the approval of the contracting officer, materials excavated from borrow pits or other parts of the work shown on the drawings may be used for constructing cofferdams.

b. The Government will assume responsibility for damage to the permanent work due to flooding by overtopping the cofferdams; provided, that the cofferdams above the county bridge leading to South Hadley Falls are constructed to elevation 58.0 m.s.l. and the cofferdams below the county bridge are constructed to elevation 56.0 m.s.l.

3-03. Maintaining existing sewers and tailraces. - a. Provisions shall be made to maintain the satisfactory operation of existing drains and sewers throughout the construction period, unless otherwise authorized by the contracting officer. Where required, the contractor shall install temporary sewer extensions and connections, including valves and specials, necessary to divert the sewage away from the work under construction as directed by the contracting officer. Payment for the installation of temporary sewer extensions and connections shall include all shoring, excavation, backfilling and other incidental work required in connection therewith.

b. Provisions shall be made to maintain the normal discharge through the existing tailraces throughout the construction period, except as otherwise provided in the contract (see Paragraph 1-07). The contractor shall install temporary flumes or conduits, or such necessary diversion works required to by-pass the tailrace discharges around or through the permanent construction for the periods authorized by the contracting officer (see Paragraph 1-07). The contractor shall be responsible for the adequacy of the protection afforded the permanent work, and for any damage resulting from the failure or washing out of such protection.

c. The contractor shall construct the temporary diversion works and reopen the tailraces before proceeding with the permanent construction except as authorized by the contracting officer.

d. The cofferdams at Wasteway No. 2 and the conduits from Overflow No. 2 shall be constructed to cause a minimum of interference with normal flows. The flow in Wasteway No. 2 shall not be blocked at any time.

3-04. Pumping and draining. - Before beginning work within the cofferdams or other protection works, the construction areas shall be unwatered and sewage diverted, and kept free from water and sewage throughout the working period.

3-05. Removal of cofferdams, flumes and temporary sewer connections. - When the work is finished within the cofferdams or when the need for the cofferdams, flumes, conduits or other protection works, and temporary sewer or tailrace connections no longer exists, the temporary protection works and sewer connections shall be removed as directed by the contracting officer. Care shall be taken that there shall be no obstruction to the discharge from the tailraces or from the new conduit or sewer outfalls.

3-06. Payment. - Payment for control and diversion of water and sewage during construction, the construction, maintenance, rebuilding in case of destruction, unwatering and removal of cofferdams, flumes, temporary sewer connections or other protection works, and maintenance of unobstructed flow through all existing tailraces, wasteways and sewers encountered in the work will be made at the contract lump sum price, Item 2, "Control and Diversion of Water and Sewage." Estimates for partial payments for this work will be made upon the completion of each portion of permanent construction requiring protective work and will be proportional to its total amount of protective work required.

SECTION IV. SUPPORT OF RAILROAD TRACKS (Item 3).

4-01. Work included. - The contractor shall arrange his operations under the contract so that service on the several railroad sidings can be satisfactorily maintained by the railroad company. In general, the railroad traffic consists of one local freight train per day with necessary local car shifting. The contractor shall furnish all materials and labor and do all the work required to provide support for the tracks by blocking, shoring, construction of temporary bridges or otherwise as required, to the satisfaction of the contracting officer and the railroad company. Where sheeting is necessary to maintain the required slope lines of the excavation for permanent structures it will be paid for under Item 9 or 10, as applicable. (See Paragraph 5-08d.)

4-02. Description. - At the following locations and wherever else tracks may be affected by operations under the contract, the contractor shall provide the necessary supports as specified under Paragraph 4-01.

a. At stop-log structures Nos. 1, 4 and 5, the steel sheet pile cut-off shall be driven across the tracks as required and the tracks shall be blocked up to allow for excavation and pouring of the concrete slab.

b. At Gate Structure No. 6 of the track on the riverside of the flood wall shall be carried across the temporary bulkhead construction for the tailrace conduit on a bridge span approximately 30 feet in length and supported on pile bents.

c. Between stations 34+50 and Stop-log Structure No. 5 the track may require support for a distance of approximately 200 feet and the excavation slopes shall be sheeted as may be found necessary. Between Gate Structure No. 7 and station 42+40 the track shall be supported for approximately 250 feet. The track shall also be supported at Gate Structure No. 8 and between station 44+90 to 48+50.

d. At gate Structures Nos. 9, 10, 11 and 12 the track shall be supported as may be found necessary.

4-03. Drawings for approval. - Prior to the start of construction operations the contractor shall submit to the contracting officer, for approval, drawings in triplicate of all structures for support of tracks.

4-04. Payment. - a. Payment for the support of railroad tracks during the progress of the work will be made at the contract lump sum price for Item 3, "Support of Railroad Tracks" and shall include the cost of all labor, materials and equipment necessary for maintaining railroad service as required by these specifications, except sheeting specifically included under Items 9 and 10 and repairs and adjustments to rails and ties which are to be done by others (see Paragraph 1-22b).

b. Estimates for partial payments for this work will be made upon restoration of each portion of road bed for normal operation and will be proportional to the total amount of track support required.

SECTION V. EXCAVATION (Items 4 to 10 incl.)

5-01. General provisions. - a. Scope of work. - The location, character of the proposed structures, the location and logs of borings and test pits are shown on the drawings (see Paragraph 1-04). It is the intent of the Government to excavate to the lines and grades given thereon, excepting at locations where limited clearances to existing structures require sheeting (see Paragraph 5-08), but the right is reserved to modify any part of the work if, in the opinion of the contracting officer, conditions require such modification (see Articles 3 and 4 of the contract).

b. Disposal of material. - (1) Materials from the excavations, except stripping, shall be used, if possible, in the permanent construction as directed by the contracting officer. No material shall be wasted unless specifically authorized by the contracting officer. If, at the time of excavation, it is not possible to place the material in the proper section of the permanent construction, it shall be stock-piled in approved areas for later use. Materials from the excavations that are unacceptable for use in the permanent construction shall be wasted in spoil areas in approved locations as directed by the contracting officer. After completion of all excavation, the spoil areas shall be neatly dressed, smoothly graded, sloped for drainage, and left in a slightly condition, all as directed by the contracting officer.

(2) Topsoil and sod obtained from the excavation and stripping operations shall be stock-piled in an approved location to be used later in dressing embankments.

c. Measurement. - (1) Excavation will be measured in place and the volume thereof will be based on surveys of the areas to be excavated made just prior to the commencement of the work, and on the excavation lines indicated on the drawings or such modifications thereof as may be necessary to adapt them to the changes referred to in subparagraph a above.

(2) Excavation from borrow areas will be based on surveys of the areas just prior to the commencement of work, and the bottom surface shown by a survey made as soon as practicable after completion of excavation operations.

d. Payment. - (1) Items included. - The contract prices for the various classes of excavation shall include the cost of all labor, plant and incidental costs, for excavating, loading, hauling and disposing of the material in the embankment or spoil areas, including any stock-piling and rehandling.

(2) Construction roads. - The cost of construction and maintenance of roads and bridges for the contractor's use will not be paid for under a separate item in the contract but shall be included in the contract prices for the other items of work.

(3) Pay lines. - Where pay or slope lines are shown on the drawings, payment for all excavations will be made to the said lines regardless of whether or not it is necessary to remove the material to slopes greater or less than those shown, excepting where sheeting is required, for the protection of existing railroads or structures and proposed foundation areas as shown on the drawings or when ordered in writing by the contracting officer, the pay line shall be to the sheeting line (see Paragraph 5-08). No payment will be made for excavation outside of the limits described above; the contractor will be required to back-fill any such excess excavation with approved material, or with concrete, where excavated surfaces are to be in contact with concrete structures, at his own expense.

(4) Shoring. - Where approved by the contracting officer, shoring may be used in lieu of excavation to the slope or pay lines shown on the drawings. The contractor shall be responsible for the unfinished work, and that workmen shall be safe from danger of cave-ins or slides during construction. Shoring may be used at the option of the contractor. If shoring is necessary for the protection of workmen or for the protection of the proposed or existing structures, and the contractor does not use it, its use will be ordered by the contracting officer. Shoring shall be erected in a safe and workmanlike manner, and shall be placed in such a way as to afford ready inspection of and ample clearance for the permanent work. Shoring shall be removed upon completion of the permanent work as soon as the construction does not require its use. Where shoring is used in excavation for structures in lieu of excavation to full dimensions of the payment lines, an estimate for excavation will be made as though the cut had been made to the payment lines indicated on the drawings. Payment will not be made for shoring as such, when installed under conditions described above, but all costs thereof shall be included in the cost of excavation.

(5) Sheeting and pumping. - Incidental sheeting, cofferdams, bulkheads, drains and other work, including pumping, required for dewatering and diversion of water, and not included in work required under Section III, shall be accomplished by the contractor and the cost thereof shall be included in the contract prices for other items of the work.

(6) Temporary drains. - The contractor shall maintain the site of the work and adjacent grounds in a well drained condition. Temporary drains and ditches required shall be constructed by the contractor at his own expense.

5-02. Definitions. - a. All materials excavated will be classified as common or rock excavation in accordance with the following definitions:

(1) Common excavation shall include all excavation not otherwise classified, required to complete the work on the drawings, that can be removed by hand, power shovels, or draglines without continuous and systematic blasting, boulders and detached pieces of solid rock or masonry less than 1/2 cubic yard in volume.

(2) Rock excavation shall include all solid rock in place that cannot be excavated by hand, power shovels, or draglines without continuous and systematic blasting, also all boulders or rock fragments 1/2 cubic yard or greater in volume.

(3) Detailed classification is as follows:

(a) Common Excavation (see Paragraphs 5-03, 5-04 and 5-05).

General (Item 4).

Borrow Areas (Items 5 and 6)

Trench (Item 7).

(b) Rock Excavation (Item 8) (see Paragraph 5-07).

b. All shoring and sheeting required in special locations as shown on the drawings and for which payment is not included in the contract prices for excavation, will be classified as follows:

(1) Sheeting (see Paragraph 5-08).

(a) Timber Sheeting (Item 9).

(b) Steel Sheeting, Driving and Removing (Item 10).

5-03. Common excavation - general (Item 4). - a. Work included. - The contractor shall excavate and dispose of the materials classified as common excavation above and below the mean water level in the river to the lines and grades shown on the drawings for the respective areas, or as otherwise directed by the contracting officer. Excavation shall be performed in accordance with a schedule of operations to be approved by the contracting officer. Common excavation includes excavation for the foundation of the concrete flood wall, stripping under the earth dike (additional to that included under Item 1), and any other required common excavation for structures, drains and ditches not included in other items of the work.

b. Description. - Excavations shall be made wide enough to permit proper sheeting, bracing and form work where necessary. Foundations for the concrete flood wall shall be excavated to neat lines to allow placing of concrete footings without forms on undisturbed material.

c. Disposal of materials. - See Paragraph 5-01b. Excavated materials not used in permanent construction may be used in temporary construction if approved by the contracting officer.

d. Measurement and payment. - (Item 4) (See Paragraph 5-06).

5-04. Common excavation - borrow areas (Items 5 and 6). - a. Work included. - The contractor shall excavate under Items 5 and 6 in the indicated borrow areas or other approved areas, the materials to be used in the dike or miscellaneous fills. Excavation shall include the transportation of the material to the point of disposal. Borrow excavation shall include the stripping of the areas and disposal of objectionable topsoil containing roots or other debris, and the removal and the disposal of any other objectionable materials so designated by the contracting officer. To provide suitable fill materials, excavations shall be made to the depths and in the locations as directed by the contracting officer. During and after excavation the borrow areas shall be graded so that all surface water will drain readily from them. The borrow areas shall be dressed smoothly and evenly, left in a neat condition satisfactory to the contracting officer, and shall be graded so that the slopes blend into the surrounding topography.

b. Description. - Under Items 5 and 6 shall be included the excavation from the borrow areas as shown on the drawings. The limit of excavation in the vicinity of the earth dike shall be that expressly directed by the contracting officer. No borrow excavations shall be permitted within 300 feet of the toes of the dike.

c. Disposal of materials. - The provisions of Paragraph 5-01b shall apply.

d. Measurement and payment. - See Paragraph 5-06.

5-05. Common excavation - trench (Item 7). - a. Work included. - The contractor shall excavate and dispose of the materials in trenches both above and below the water level in the river to the lines and grades shown on the drawings, or as otherwise directed by the contracting officer. The required depth of the trenches at all points cannot be known with certainty until the area is fully developed by the construction operations. The lines and grades shall include any necessary adjustment to field conditions. Trench excavation shall include excavations for drains, pipe lines, sewers, cut-off trenches and any other trench excavation not included in any other item as directed by the contracting officer and the width of which does not exceed 5 feet and the depth is not less than the width of the excavation. Sheet piling shall be furnished and installed below the water level in the river (see Paragraph 5-08).

b. Pumping and draining. - The contractor shall do all pumping and draining necessary to perform the excavation in the dry, and to keep the cut-off trench unwatered until it has been satisfactorily back-filled with suitable material as provided for under Section III.

c. Disposal of materials. - The provisions of Paragraph 5-01b shall apply.

5-06. Measurement and payment. - Measurement for excavation work under Items 4 to 7, inclusive, will be made in accordance with Paragraph 5-01c. Payment for all work in connection with excavation under Items 4 to 7, inclusive, including the loading, hauling, and disposal of the materials, temporary protection, bulkheads and shoring, will be made at the contract unit prices for Items 4, 5, 6 and 7, as applicable for the several items of excavation (see Paragraph 1-05); provided that payment for required sheeting as shown on the drawing or ordered in writing by the contracting officer, will be made under Items 9 and 10 (see Paragraph 5-08).

5-07. Rock excavation (Item 8). - a. Work included. - The contractor shall excavate and dispose of the rock excavated above and below the mean water level in the river to the lines and grades shown on the drawings or otherwise directed by the contracting officer. Rock excavation shall be done in the preparation of foundations for structures as shown on the drawings. Rock excavation under Item 8 shall include rock excavation in sheeted or open areas and any other ordered rock excavation not included in other items of the work.

b. Shoring. - The provisions of Paragraph 5-01d (4) shall apply.

c. Blasting. - (1) Blasting and the use of explosives shall be conducted as provided for in Paragraph 1-28.

(2) Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and adjacent property. All damage done to the work or adjacent property shall be repaired. All operations of the contractor in connection with the transportation, storage, and use of explosives shall be as approved by the contracting officer.

(3) Explosives of such quality and power shall be used in the locations which will, in the opinion of the contracting officer, neither crack nor damage the rock outside the lines of excavation. Blasting shall be done only to the lines and grades shown on the drawings or approved by the contracting officer.

(4) The foundation shall be prepared by drilling, picking, barring, wedging, or similar methods which will leave the rock of the foundation in a solid and unshattered condition. Where required by the contracting officer, the rock shall be cut into rough steps or benches.

to provide better bond and bearing surfaces. To aid inspection and to insure good bond with the concrete, the foundation shall be thoroughly cleaned by streams of water or jets of air, or a combination of both, as required by the contracting officer (see Paragraph 11-13d (3)).

(5) Approval by the contracting officer of the method of blasting or the strength and amount of the explosive used, will not relieve the contractor of his responsibility in the blasting operations.

(6) Generally the faces of rock excavations shall be scaled to a tolerance not exceeding one foot each way from the designated neat-line for excavation shown on the drawings.

d. Disposal of materials. - The provisions of Paragraph 5-01b shall apply also to Item 8. Some stock-piling may be necessary.

e. Measurement and payment. - The quantity to be paid for under Item 8 will be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or as directed. Quantities will be measured in place before excavation in accordance with Paragraph 5-01c. Where a neat-line is shown on the drawings, the quantities will be the quantities measured or computed to the neat-line. Payment shall include the disposal of all excavated materials and all shoring except as provided under Paragraph 5-08, or other incidental work. Payment will be made at the contract unit price for Item 8, "Rock Excavation."

5-08. Shooting (Items 9 and 10). - a. Work included. - (1) The contractor shall furnish and install the shooting required for excavation work adjacent to railroad track and at other special locations as shown on the drawings or as directed in writing by the contracting officer. "Timber Shooting," Item 9, shall be left in place at steps in wall footings as shown on the drawings, unless otherwise directed by the contracting officer. "Steel Shooting," Item 10, shall be removed except when ordered in writing by the contracting officer to be left in place. In addition to the payment to be made under Item 10, the contractor will be paid for all steel shooting required to be left in place at the rate of \$40.00 per ton.

b. Materials. - (1) The timber shooting shall be of the dimensions required for strength or as directed by the contracting officer. Timber for walos and braces shall be of economical dimensions, acceptable in modern practice. All timber used shall be sound and of good quality, and shall meet the approval of the contracting officer. Bolts and other hardware shall conform to current standard practice for the material required and use intended.

(2) The steel sheeting shall conform to the provisions of Paragraphs 6-02 and 6-03, unless otherwise shown on the drawings, to the extent necessary in the opinion of the contracting officer. Previously used material suitable for the use intended and the conditions of the work may be used if approved by the contracting officer.

c. Installation. - The sheeting shall be driven as true as possible to the lines and grades necessary to accomplish the excavation, without injury to the piling, and shall be cut off where necessary. Necessary wales and bracing shall support the sheeting in a manner satisfactory to the contracting officer.

d. Measurement and payment. - (1) Payment for all timber sheeting installed as shown on the drawings or as directed by the contracting officer, will be for the number of thousand feet board measure installed. The measurement will be based on commercial sizes of squared timber, except as to length, which shall be the net length placed with no deduction for beveled ends. Payment will be made at the unit contract price for Item 9, "Timber Sheeting."

(2) Payment for all steel sheeting installed as shown on the drawings or as directed by the contracting officer will be for the number of square feet of steel sheeting installed. Payment will be made at the unit contract price for Item 10, "Steel Sheeting."

(3) The wales and bracing will not be measured for payment but the cost thereof, together with the cost of all hardware, the removal of such sheeting as the contracting officer may direct, and all other incidental work shall be included in the contract prices for the sheeting.

SECTION VI. STEEL SHEET PILING CUT-OFF (Item 11).

6-01. Work included. - The contractor shall construct the steel sheet piling cut-off under the concrete flood wall and other permanent structures as shown on the drawings. The cut-off shall be constructed of piles of varying lengths, including specials, driven to grade, between the limits as shown on the drawings.

6-02. Type and properties. - The piles shall be of the arch web type and shall have a minimum thickness of metal of 3/8 inch, except that a reasonable reduction for shaping the joints of the interlock will be permitted. The piles shall provide a section modulus of not less than 5.4 inches cubed per linear foot of cut-off, and shall weigh not less than 22 pounds per square foot of cut-off, exclusive of any welded or riveted connection or reinforcement. The interlocked joints shall develop a strength in direct tension of not less than 8,000 pounds per linear inch of interlock without rupture. The piles shall be continuously interlocked throughout their entire length and shall be provided with standard pulling holes located as shown on the drawings. The type and dimensions of the piles the contractor proposes to furnish shall be submitted to the contracting officer for approval before any piles are delivered to the work.

6-03. Material. - The steel for the sheet piling shall be new and shall conform to Federal Specification QQ-S-751a for "Steel: Structural (Including Steel for Cold Flanging) and Steel: Rivet (for) Ships other than Naval Vessels", Structural Grade, except for the following requirements:

a. Tensile Strength shall be not less than 70,000 pounds per square inch, except that fabricated sections such as corner piles, tee piles and other special sections shall be of steel having a tensile strength of not less than 60,000 pounds per square inch.

b. Bend Test Specimens shall withstand bending 180 degrees around a pin with a diameter twice the thickness of the specimen without fracture on the outside of the bend.

6-04. Driving. - The piles shall be driven to form a continuous interlocking diaphragm down to the elevation established for the bottom of the cut-off, as shown on the drawings. Special care shall be taken to avoid damage to sewers, drains, and conduits encountered in the work. A protecting cap shall be used in driving. The hammers shall be of a suitable size and type, either steam or air operated. The use of a water jet may be permitted at the discretion of the contracting officer. Piles shall be driven without injury to them, as true to line and grade as possible, and shall be cut off, where necessary, to the top elevation of the sheet piling cut-off and trimmed to vertical lines at steps in the foundations as shown on the drawings. Proper precautions shall be taken to prevent rupture at the interlocks. Piles ruptured at the inter-

lock or otherwise injured shall be removed and replaced by new piles at the contractor's expense. Special sections, including trees, corners and wedges, shall be installed as shown on the drawings, or if in the opinion of the contracting officer, such sections are necessary to insure proper construction of the sheet piling cut-off.

6-05. Measurement and payment. - The quantity of steel sheet piling to be paid for will be the number of square feet of sheet piling actually in place as shown on the drawings. Payment will be made at the unit contract price for Item 11, "Steel Sheet Piling," and shall include the costs of all labor, materials, equipment and incidentals required to construct the permanent sheet piling cut-off as specified. Portions of the piling that are cut-off and removed will be paid for at 50 per cent of the contract price. Lengths of piling in excess of those required by the drawings or ordered by the contracting officer will not be paid for.

SECTION VII. EARTH DIKE (Items 12 and 13).

7-01. Definitions. - The term "embankment" as used in these specifications includes earth fill of two types for the earth dike and cut-off trench, and all other specified or directed earth fills within the limits of the dike necessary to complete the embankment. As shown on the drawings, the two types of earth fill are "selected impervious" under Item 12, for the cut-off trench and core of the dike; and the "random pervious" under Item 13, forming the both shoulders of the embankment.

7-02. Work included. - The contractor shall grade and consolidate materials required for the embankment, to the elevation, lines, grades and cross sections shown on the drawings, with such increased height and width as may be deemed necessary by the contracting officer to allow for later shrinkage or settlement. The contractor shall use suitable materials as approved by the contracting officer and excavated from the required excavations and approved borrow areas shown on the drawings.

7-03. Materials. - a. General. - All materials from required excavations will be used, if, as excavation proceeds, they are found suitable by the contracting officer for use in the embankment. Brush, roots, sod, any type of organic materials, and other perishable or unsuitable material as determined by the contracting officer shall not be placed in the embankment. Materials shall not be wasted except by specific instructions from the contracting officer.

b. Borrow. - Other suitable materials shall be borrowed from locations shown on the drawings in accordance with Paragraphs 1-26 and 5-04. The origin of any material from either structure or borrow excavations does not definitely determine where it will be used in the embankment. Materials from two or more excavation or borrow areas may be required to be used at the same time and in the same part of the embankment, mixing being done in the process of placing by systematic dumping, spreading and bulldozing. Materials from one area may be required to be used in different parts of the embankment.

c. Test requirements. - The various types of earth fill defined in Paragraph 7-01 shall conform to the test requirements and approved classification established by the Soils Laboratory, U. S. Engineer Office, Providence, Rhode Island.

7-04. Plowing. - Immediately prior to the placing of materials in the embankment, the entire foundation of the embankment shall be thoroughly plowed and broken to a depth of 4 inches. The furrows shall run approximately parallel to the axis of the embankment. All roots, stones, and debris or other objectionable material shall be removed and disposed of, as directed by the contracting officer. The condition of the surface material of the foundation area at the time of

plowing shall be slightly drier than the required moisture content for rolled embankment. The requirements for plowing do not apply to the side slopes of the cut-off trench, and stump holes. Plowing shall be completed not less than 200 feet in advance of the embankment construction. After plowing, the entire surface of the foundation area shall be rolled in accordance with Paragraph 7-06d.

7-05. Filling of excavations in embankment area. - a. - General. - The cut-off trench, test pits, stump holes, and other excavated area within the limits of the embankment and as otherwise shown on the drawings shall be filled with random, pervious, or impervious materials in the dry as directed by the contracting officer. The fill shall be placed in layers, moistened, and rolled in accordance with Paragraph 7-06 whenever, in the opinion of the contracting officer, it is possible to do so. Material which cannot be compacted by roller equipment on account of clearances, shall be spread in 2-inch layers and compacted with hand or power tampers which shall give the degree of compaction required for the embankment. As the fill is brought up, the side slopes of the cut or hole shall be scarified by equipment or by hand if it is required, in the opinion of the contracting officer, in order to provide a bond between the fill and the original ground material (see Paragraph 7-06d(2)).

b. Stump holes. - The sides of stump holes shall be broken down with bulldozers or a disc harrow so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place.

c. Cut-off trench. - The fill for the cut-off trench shall be placed in the dry and rolled in accordance with Paragraph 7-06. The water shall be drained to a sump and removed by pumps. The fill shall be made by working the materials toward the sump and sloping the surface of the fill longitudinally toward the sump. Well points may be used for drying up the foundation when approved by the contracting officer.

7-06. Rolled fill. - a. General. - The selected impervious, and random pervious sections of the embankment shall be constructed with a crown running with the center line of the dike and with slopes approximately on a 2 per cent grade toward the edges of the embankment. This slope shall be maintained until the completion of the embankment, thus bringing up together the impervious and random pervious sections, unless otherwise directed by the contracting officer. As soon as practicable, the embankment shall be brought to a nearly uniform grade for the entire length.

b. Furnishing and placing. - (1) The contractor may use power shovels, drag lines, or any type of excavating machinery which is capable of excavating the materials in dry condition. The contracting officer will specify the location of the borrow areas and the depth to

which excavation shall be made. The contractor may use any approved method of transporting materials in natural dry condition. The dumping of the successive loads shall be at locations as directed by the contracting officer. Sufficient excavating and hauling equipment shall be available so that not less than two sources of material can be worked at the same time. When two or more different materials are being moved into a section of the embankment they shall be spotted and dumped systematically so that in any area of the section there are approximately the required proportions of the materials. After dumping, the materials for the impervious sections shall be bulldozed or otherwise spread in approximately 8-inch layers and rolled (see Paragraph 7-06d). The random-pervious materials shall be spread in layers approximately 12 inches in thickness as determined by the contracting officer and rolled (see Paragraph 7-06d). Should the material for the various sections of the embankment be too high in water content when dumped, it shall be bulldozed or otherwise spread and harrowed or stirred for a sufficient time to allow the surplus water to dry out before being rolled. If, in the opinion of the contracting officer, the rolled surface of any layer of the materials is too smooth to bond properly with the succeeding layer or, if the materials have dried out sufficiently to cause cracks in the surface, it shall be roughened or loosened by a disc harrow, or other approved means, and dampened, if required, before the succeeding layer is placed thereon. All roots, trash, and debris shall be promptly removed from the embankment and disposed of to the satisfaction of the contracting officer. Stones greater than 6 inches in diameter shall be removed from the impervious and random pervious sections and only when approved by the contracting officer, shall be placed in the random-pervious section of the embankment. The entire surface of the embankment shall be maintained in such condition that construction equipment can travel thereon. Routing of construction equipment on the embankment shall be subject to direction by the contracting officer.

(2) Any embankment material lost, or loosened, after being placed in the embankment and before the completion of the contract and acceptance of the completed work, because of any operation of the contractor or for other causes that in the opinion of the contracting officer were avoidable or under the control of the contractor, shall be replaced by the contractor to the satisfaction of the contracting officer and without cost to the Government. For payment for additional material required through no fault of the contractor, see Paragraph 7-11c.

(3) The contractor shall cease work on the embankment at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, high water, cold weather, or other unsatisfactory conditions.

c. Moisture control. - To obtain the desired degree of compaction for the varying kinds of materials used, the moisture con-

tent of the material being placed shall be the optimum required for satisfactory compaction, as determined by the contracting officer. If required, the compacted surface shall be sprinkled as directed immediately before placing each new layer. The moisture content shall be sufficient to dampen the fill materials as required, but the amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to the rolling. An adequate supply of water shall be available. Jets shall not be directed at the embankment material with such force that the finer materials are washed out.

d. Compaction. - (1) Tamper type roller. - Rolling for the impervious section of the embankment shall be done by a tamper type twin roller such as a "sheeps-foot" roller, water or sand ballasted, having tamper foot uniformly staggered over its cylindrical surface, and equipped with cleaners; or other satisfactory type of tamper roller as approved by the contracting officer. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5 and not more than 7 square inches. The spacing shall be such as to provide a minimum of two tamping foot for each square foot of cylindrical surface. Addition or reduction in the number of tamping foot shall be made when directed by the contracting officer. The total weight of the roller in pounds divided by the total area of the maximum number of tamping foot in one row parallel to the axis of the roller shall be not less than 115 pounds per square inch tamping foot area with the drum empty, and not less than 200 pounds per square inch tamping foot area with the drum ballasted. The design and operation of the tamping roller shall be subject to the approval of the contracting officer.

(2) Rolling impervious section. - When the moisture content and condition of the spread impervious layers of the embankment are satisfactory to the contracting officer, the contractor shall roll the impervious section of the embankment with tamper type twin rollers. Each set of twin rollers shall be pulled by a crawler type tractor of suitable power, weighing not less than 20,000 pounds, manufacturer's standard weight, at a speed of approximately 2-1/2 miles per hour. Each square foot of each layer of the embankment material shall be compacted by not less than six passes of the rollers, and ordinarily not more than nine passes as required by the contracting officer. Successive trips of rollers shall overlap by at least 2 feet. Failure to comply with this requirement for careful rolling will be a cause for additional trips at the contractor's expense. Where new material abuts old material, either in place or in embankment, the old material shall be cut or broken by machine or hand methods approved by the contracting officer, until it shows the characteristic colors of undried materials, and the rollers shall work on both materials, bonding them together. Portions of the earth fill which the roller cannot reach for any reason shall be thoroughly compacted by tamping with hand or power tampers in 2-inch layers. The degree of compaction for such portions of the earth fill shall be equivalent to that obtained by sprinkling and rolling as specified for the other portions of the earth fill.

(3) Rolling random-pervious sections. - Rolling of the random-pervious sections of the embankment shall be the same as specified above except that a minimum of 3 passes of the rollers will be required. When conditions of the work so require, at the direction of the contracting officer, rolling may be done by a crawler type tractor weighing not less than 20,000 pounds; in such cases a maximum of four passes of the tractor treads on each square foot of embankment area will be required.

(4) Tests for compaction. - Samples of all embankment materials for testing, both before and after placing and compaction, will be taken at frequent intervals by the contracting officer. Corrections, adjustments, modifications of methods, selection of material and moisture content will be made from these tests to secure the maximum density of the materials in the embankment (see Paragraph 7-03c.

e. Impervious fill. - Impervious fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall be placed in the select impervious section of the embankment throughout the entire length.

f. Random-pervious fill. - Random-pervious fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall be placed in the random section of the embankment. In general this material shall be placed so the coarser portions are toward the outside edge, and the finer portions near the select impervious section, so that a gradational transition is effected from the impervious to the pervious sections.

7-07. Removal of objectionable material. - The contractor shall, when directed by the contracting officer, excavate, remove and dispose of any material from the embankment sections which the contracting officer considers objectionable in such locations, and refill the area as directed in accordance with Paragraph 7-05.

7-08. Slides. - In cases of slides in any part of the embankment during the construction or after completion, but prior to the final acceptance of the work, the contractor shall cut out and remove the area specified by the contracting officer and then rebuild the excavated area in accordance with these specifications. In case it is determined that the slide was caused through the fault of the contractor, the foregoing shall be performed at no cost to the Government.

7-09. Frozen materials. - No earth shall be placed upon a frozen surface, nor shall frozen earth, snow or ice be placed in the embankment. In cases of emergency the contracting officer may require frozen material to be stock-piled for later use in the embankment.

7-10. Shrinkage or settlement. - No measurement will be made of additional material placed on account of settlement of the foundation

or shrinkage during construction. The cost of placing and compacting such additional material shall be included in the contract prices for the various items of fill. Measurement and payment of all required fill material excavated and transported to point of placement will be in accordance with Section V.

7-11. Measurement and payment. - a. The quantities to be paid for under Items 12 and 13 will be the number of cubic yards placed as directed, measured in place after compacting. Payment shall include the work of preparing the base, spreading in layers, wetting, rolling or tamping, trimming to line, and shall include all labor and materials incidental to completing the embankment, not specifically included under other items. Payment will be made at the contract unit price under Item 12 "Impervious Fill" and Item 13, "Random Porvius Fill" (see Paragraph 1-05).

b. To determine the quantities to be paid for, a survey will be conducted prior to the beginning of the placing of the fill. The true surface condition will be shown by cross sections and profile and the measurement of the quantities will be based upon this survey. The quantities will be the volume between the original surface at the beginning of the work, and the slope lines and grades as indicated on the drawings, as staked in the field, or as directed by the contracting officer at the completion of the work.

c. Additional payment will be made to replace embankment washed out by flooding or scouring, or that required to be removed on account of slides, or the removal and disposal of all objectionable materials placed at the direction of the contracting officer; provided such replacement of embankment was not caused by negligence or carelessness of the contractor. Quantities for additional payment will be measured as directed by the contracting officer, and payment will be made at the applicable unit contract prices.

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SECTION VIII. MISCELLANEOUS FILL AND BACKFILL (Items 14 to 16 incl.)

8-01. Gravel bedding (Item 14). - a. Work included. - The contractor shall place a layer of gravel upon which riprap will be placed at the locations shown on the drawings and as indicated by the contracting officer. The contractor shall also place a layer of gravel of the specified quality required for drains at the locations shown on the drawings or as directed by the contracting officer.

b. Materials. - Gravel bedding shall consist of suitable coarse clean gravel satisfactorily graded within the specified limits. Unless otherwise directed, not more than ten per cent by weight shall pass a sieve having 10 meshes to the inch, and all shall pass a 2-inch square mesh screen.

c. Placing. - The material shall be placed as shown on the drawings or as directed, and with such hand-placing as may be necessary to trim to the required slopes. The contractor will not be required to tamp or roll the material, but shall consolidate it with water to the extent directed so that no settlement will later result.

d. Measurement and payment. - The quantity to be paid for under Item 14 will be the number of cubic yards placed to the limits shown on the drawings, or ordered. Payment will be made at the unit contract price for Item 14, "Gravel Bedding."

8-02. Random backfill (Item 15). - a. Work included. - The contractor shall place, grade and consolidate materials required for random backfill around structures, over pipe drains and culverts, and at other locations as directed by the contracting officer. The material shall be placed in 12-inch horizontal layers with only such hand-placing as may be necessary to trim to the required slopes. The contractor will not be required to roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result. Hand tamping shall be done for good compaction at or near pipes and structures and where required by the contracting officer.

b. Materials. - Materials shall be borrowed from stockpiles of excavated materials (see Paragraph 5-01b), or may be obtained directly from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish or other unsuitable materials or substances.

c. Measurement and payment. - Measurement will be made by the cubic yard for the amount of random backfill placed in the completed work to the lines and grades shown on the drawings or as directed by the contracting officer. Quantities will be measured in place after any settlement. Payment for all work in connection with placing

random backfill will be made at the contract unit price, Item 15, "Random Backfill."

8-03. Rock fill (Item 16). - a. Work included. - (1) The contractor shall furnish all equipment and labor required to construct the dumped rock fill on the slope of the river bank as shown on the drawings or as directed by the contracting officer.

(2) The contractor shall do all the preliminary grading and other incidental work, not included in any other item, required to prepare the site for the rock fill.

b. Material. - (1) Rock fill shall be composed of durable stone or concrete fragments of acceptable sizes. Suitable rock, boulders and large cobbles from borrow areas and from the required excavations (see Paragraph 5-07), shall be used. The contractor need not place rock fill by hand, except to rearrange surface stones as necessary to fill unsatisfactory depressions in the surface below the required grades. The rock shall be carefully dumped in place with the larger rocks at the outer faces and the smaller rocks and spalls adjacent to the river bank. The rock fill shall consist of fragments of stone of which none shall be smaller than one cubic foot and of which those exceeding one-fourth cubic yard shall constitute at least 50 per cent of the volume, except as otherwise authorized by the contracting officer.

(2) Generally the maximum allowable size of single pieces of rock shall be 1/2 cubic yard; with sizes grading with reasonable uniformity up to the specified maximum, a tolerance of 6 inches above and 12 inches below the finished slope lines will be permitted.

c. Measurement and payment. - The quantity to be paid for under Item 16 will be the number of cubic yards of rock fill furnished and placed to the specified lines or grades in the completed work. Payment will be made at the contract unit price for Item 16, "Rock Fill." The unit contract price shall include payment for all equipment, labor and incidentals required to construct and trim the rock fill.

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SECTION IX. RIPRAP MASONRY AND DRAINS (Items 17 to 20 incl.)

9-01. General. - "Riprap - Hand-Placed," Item 17, will be required to replace part of the existing dry rock masonry walls, for paving at the tailrace outlets and dike as directed by the contracting officer; and "Riprap - Grouted," Item 18, will be required for paving near the outfall from the pump stations and elsewhere as shown on the drawings. "Rubble Masonry," Item 19, will be required in the locations as shown on the drawings. "Rock Drains", Item 20, refers to the rock drains shown on the drawings and required for the concrete flood wall and the earth dike.

9-02. Riprap (Items 17 and 18). - a. Work included. - (1) Under Item 17, part of the existing dry rubble masonry wall shall be relaid and trimmed as directed by the contracting officer, and surfaces at the tailrace outlets and at drainage inlets shall be riprapped at the locations shown on the drawings and elsewhere as required by the contracting officer.

(2) Under Item 18, hand-placed riprap shall be placed by the contractor to the lines and grades shown on the drawings, for paving near the outfall from the pump stations as shown on the drawings or elsewhere as directed by the contracting officer. The contractor shall also furnish and place grout for surface grouting of this riprap.

b. Material and placing. - (1) Riprap shall be of durable rock of acceptable sizes with a specific gravity of not less than 2.65. Suitable rock from the required excavation of the existing dry rubble wall shall be used together with such additional stone required as specified in Paragraph 9-03 b (1). The riprap shall be laid to the lines and grades shown on the drawings or as directed. A tolerance of 3 inches above or below the grade line shown on the drawings will be allowed for the finished grade surface of the hand-placed riprap. Rock for riprap shall be angular and of uniform shape so as to furnish an even, reasonably smooth surface. Not more than 5 per cent by weight of the rock shall be smaller than one-half cubic foot in volume and at least 75 per cent of the rock used shall be from 1/2 to 1 cubic foot in volume with one dimension approximately equal to the depth of the riprap course. The rock shall be closely laid on a base of gravel bedding (see Paragraph 8-02), with the dimension approximately equal to the depth of the course normal to the slope, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

(2) Grouting shall be done on clean riprap surface with a grout mixture of 1 part Portland cement and 2-1/2 parts sand by volume combined with water to a suitable consistency. Cement and sand used in the grout shall be obtained from approved commercial sources

and subject to the approval of the contracting officer. The grout shall be worked into the joints of the riprap surface with brooms or other means so as to fill the voids completely.

c. Measurement and payment. - (1) The quantity to be paid for under Item 17 will be the number of cubic yards of riprap satisfactorily placed in the completed work to the specified or ordered lines and grades. Payment will be made at the contract unit price for Item 17, "Riprap - Hand-Placed." The unit contract price shall include payment for furnishing, hauling and placing the riprap.

(2) The quantity to be paid for under Item 18 will be the number of cubic yards of riprap placed to the specified lines and grades in the completed work. Payment shall include all costs for furnishing, hauling, placing and grouting the riprap. Payment will be made at the contract unit price for Item 18, "Riprap-Grouted."

9-03. Rubble Masonry (Item 19) - a. Work included. - The contractor shall furnish all labor, equipment and material and do all work required to construct the rubble masonry walls at the locations and to the dimensions as shown on the drawings or as directed by the contracting officer.

b. Materials. - (1) Stone. - The stone used in the rubble masonry work shall be selected native stone of suitable size, quality, shape, color, and texture for the work, as determined by the contracting officer. The stone shall be sound, clean, strong, durable, and free from any defects that might affect its strength or injure its appearance. Each piece shall weigh not less than 25 pounds and not more than 250 pounds, with not more than 10 per cent by weight weighing less than 75 pounds. The stone shall be approximately rectangular in cross section, each piece having its greatest dimension not more than three times its least dimension. It is anticipated that stone of suitable quality will be available near the site of the work, but whether or not such stone is so available, the contractor shall be solely responsible for furnishing stone meeting the requirements of these specifications.

(2) Mortar. - Mortar for rubble masonry shall be mixed in the proportions of 1 part Portland cement, 2 parts sand, and 3 parts fine gravel. Cement, sand, and fine gravel shall conform to the provisions of: Paragraph 11-05 for Portland cement; Paragraph 11-06 for fine aggregate (sand), and Paragraph 11-07 for coarse aggregate as specified therein for number one (1) aggregate for maximum size mesh screen, 1 inch to 2 inch inclusive. Mortar shall be prepared in such quantities that it can be used entirely before it shall have obtained its initial set, and in no event shall any mortar be used after it has been mixed for a period longer than 30 minutes. Retempering of mortar will not be permitted.

c. Workmanship. - All stone shall be laid by skilled and experienced stone-setters in strict accordance with the drawings and

specifications. Each stone shall be brushed clean and thoroughly drenched with clean water immediately before laying and carefully bedded in a full bed of mortar. Stones shall be lowered carefully into their mortar beds so as not to injure their exposed faces nor jar adjacent stones. Stones shall be accurately set with joints not exceeding 2 inches in width. The exposed face of the stone shall not vary from the neat wall surface as shown on the drawings by more than 2 inches. Joints shall be raked and dressed to a depth of approximately one inch from the face of the stone. The stone shall be laid in courses roughly leveled up. The bottom or foundation courses shall be composed of large selected stone. All horizontal joints shall be parallel and the vertical joints in each course shall break joints with those in adjoining courses by at least 6 inches.

d. Measurement and payment. - The quantity to be paid for under Item 19 shall be the number of cubic yards of rubble masonry satisfactorily placed in the work. The measurement of volume shall be to the neat lines shown on the drawings or as staked in the field. Payment will be made at the unit contract price for Item 19 "Rubble Masonry."

9-04. Rock for drains. - (Item 20). - a. Work included. - The contractor shall construct rock drains as indicated on the drawings, or as otherwise required by the contracting officer.

b. Description. - (1) The trenches and other excavations for the drains shall be to the dimensions and in the locations shown on the drawings, except as otherwise directed by the contracting officer. The drains shall be constructed so that the longitudinal slope will be towards a natural stream channel or other drain. The crushed stone backfilling used shall consist of angular fragments of uniform quality throughout, of 4-inch maximum size, free from thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. It shall be graded so that not more than 50 per cent by weight of stone will be retained on a standard mesh sieve with openings of 1-1/4 inches and not more than 15 per cent by weight shall pass a 3/4-inch mesh sieve.

(2) The drains shall be protected from concrete intermixture by the use of wood, cloth or other suitable material.

c. Measurement and payment. - The quantity measured for payment under Item 20 will be the number of cubic yards of rock fill satisfactorily placed to the specified lines or grades in the completed work. Payment shall include all costs for furnishing, hauling, placing and trimming the fill. Payment will be made at the contract unit price, Item 20, "Rock for Drains." Payment for trench excavation will be made as provided for in Paragraph 5-05d. Payment for gravel bedding will be made as provided for in Paragraph 8-01d.

SECTION X. PIPE DRAINS (Items 21 to 35 incl.)

10-01. General. - Pipe drains shall be installed for drainage from the areas back of the flood wall and for extensions to existing sewers and they shall discharge into the various tailraces. All drains and connections shall be installed as shown on the drawings. Manholes and inlets shall be constructed at the locations shown on the drawings or as directed by the contracting officer. Provisions for pumping or diverting the water shall be made (See Sections III and V).

10-02. Tile, reinforced concrete and cast iron pipe (Items 21 to 35 incl.). - a. Work included. - The contractor shall furnish and lay all tile, reinforced concrete and cast iron pipes, including specials of the required sizes and dimensions for the drainage systems as shown on the drawings.

b. Materials. - Tile pipes shall be bell-and-spigot, vitrified, clay pipe, conforming to the requirements of Federal Specification SS-P-361, or subsequent amendments or revisions thereof. Reinforced concrete pipes shall be bell-and-spigot pipe conforming to the requirements of Federal Specification SS-P-371 or subsequent amendments or revisions thereof and cast iron pipe shall be bell-and-spigot pipe conforming to the requirements of the current American Water Works Association specifications for the standard weight pipe, Class B. Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the contracting officer do not impair the fitness of the pipe for the purpose intended. Perforated pipe shall conform to the details as shown on the drawings.

c. Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraphs 5-03 and 5-05. Pipe trenches shall have a depth of not less than two feet with vertical sides and a width at least 12 inches greater than the outside diameter of the pipe unless otherwise shown on the drawings. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe, so that the pipe shall be firmly supported on the bottom and for at least $1/3$ of the diameter up each side. All rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids backfilled with well compacted suitable material. Suitable excavations shall be made to fit all junctions or other specials wherever needed.

d. Laying pipe. - (1) Mortar joints. - All pipe shall be placed in the trench immediately after the excavation is completed. Proper care shall be used in handling the pipe to avoid injury or breakage. The pipe shall be carefully bedded, and properly connected and jointed. Bell holes shall be excavated to insure that each pipe shall rest firmly upon its bed for the entire pipe length. The pipes

shall be laid true to the lines and grades shown on the drawings or as staked in the field. Joints shall be made with cement mortar composed of one part Portland cement and 2-1/2 parts sand. All mortar used shall be thoroughly mixed either by hand or in a mechanical batch mixer. Mortar shall be prepared in such quantities that it can be used entirely before it has attained its initial set. The minimum amount of water sufficient to make a workable mortar shall be used. Cement and sand used in mortar shall conform to the requirements of Paragraphs 11-05 and 11-06. The spigots shall be centered in the bells, and there shall be no shoulders or unevenness of any kind along the bottom half of the pipes. Special care shall be taken that the joint space be of equal width around the pipe, making use of jute or oakum gaskets soaked in cement grout to center the pipe. The mortar shall be thoroughly troweled into the joint, and a sufficient overfill shall be made to hold the mortar in the joint firmly in place. The interior of the pipe shall be carefully cleaned after laying to remove dirt, mortar and other obstructions.

(2) Open joints. - The applicable provisions of subparagraph (1) above shall apply, except for joints. Pipe with open joints shall be laid true to line and grade, with bells up grade and with spigot ends fully entered in the bells. A strip of burlap at least 6 inches in width shall be carefully and securely wrapped around the pipe joints lapping the ends of the burlap 6 inches.

(3) Lead joints. - Cast iron pipe shall be laid with the bell end pointing in the direction opposite to the flow of the water. Lead joints, where called for on the drawings, shall be made tight with pure oakum caulked into the bell of the pipe until one-third full, and the remaining two-thirds of the bell shall be poured full of molten pig lead and caulked flush with the hub.

e. Backfilling. - (1) For pipe laid with cemented joints, the backfill material shall be evenly spread and compacted under and around the pipe. Backfill over the pipe shall be done in accordance with the provisions of Paragraph 8-02, unless otherwise shown on the drawings or directed by the contracting officer. Hand tamping shall be done as directed.

(2) For pipe laid with open joints, the backfill material as shown on the drawings shall be evenly spread and compacted around and over the pipe to the limits shown on the drawings or as directed by the contracting officer (see Paragraphs 8-01 and 8-02).

f. Measurement and payment. - (1) Measurement for payment will be based on the linear feet of pipe of the respective kinds and sizes installed. Payment for pipe will be made at the contract unit prices for Items 21 to 35 respectively, and shall include all costs of furnishing and installing pipe, including specials and making joints, except the cost of excavation and backfilling.

(2) Payment for excavation will be made under Items 4 or 7 (see Paragraphs 5-03 and 5-05). Payment for backfilling will be made at the contract unit price for Items 14 and 15, (see Paragraphs 8-01b and 8-02b), as applicable to the respective backfill materials (see Paragraph 1-05). Payment for manholes and catch basins will be made at the contract unit price for Items 37, 38, 39 and 45, as shown on the drawings. (see Paragraphs 12-02 and 17-04).

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SECTION XI. CONCRETE (Items 36 to 39, incl.).

COMPOSITION, CLASSIFICATION AND STRENGTH

11-01. Composition. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

11-02. Classification. - Except where required to meet special conditions all concrete shall be either Class "A" or Class "B", as designated in Section XII and on the drawings for the various parts of the work in accordance with the conditions of application and the proportions of materials and strengths required.

11-03. Strength. - The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days, as determined by breaking standard 6-inch diameter by 12-inch height or 8-inch diameter by 16-inch height test specimens:

<u>Class</u>	<u>Average for any 25 consecutive cylinders</u>	<u>Minimum for any one cylinder</u>
A	3400 lbs. per sq. in.	2600 lbs. per sq. in.
B	3000 lbs. per sq. in.	2200 lbs. per sq. in.

11-04. High-early-strength concrete. - High-early-strength concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class. All provisions of these specifications, except for cement, shall be applicable to such concrete. Any high-early-strength cement used shall be approved by the contracting officer before use.

MATERIALS

11-05. Portland cement (Item 36). - a. The contractor shall furnish Portland cement of the quality herein specified in sufficient quantity for the work required. Cement for all concrete, grout and mortar, except as specified in Paragraph b, shall conform to Federal Specification SS-C-206, for "Cement, Portland, Moderate-Heat-of-Hardening, September 30, 1936", except that Paragraph E-7, Heat of Hydration, shall be considered inoperative.

b. High-early-strength Portland cement. - Cement for high-early-strength concrete shall be in accordance with Federal Specification SS-C-201 for "Cement, Portland, High-Early-Strength."

c. Special test requirements. - Cement will be tested by

the Government at the Central Concrete Laboratory, West Point, N. Y. No cement shall be used until notice has been given by the contracting officer that the test results are satisfactory. Cement which has been stored, other than in bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until after it has satisfactorily passed both the 7 and 28-day tests, but in cases of emergency the contracting officer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the soundness and 7-day tests; provided it is the product of a quarry and mill having established a reputation of not less than 3 years' standing, for the production of high-grade cement. If the tests prove any cement unsatisfactory which has been delivered at the site of the work, such cement shall be promptly removed from the work and its vicinity.

d. Identification. - Cement shipped in bags shall be identified by marking or tagging the bags with the identifying number or symbol of the Federal Specifications under which it was manufactured. Bulk shipments of cement shall be likewise identified by a suitable device affixed to each car or other type of bulk carrier. Marking or tagging shall be done at the mill.

e. Quality and packages. - All cement shall be dry, finely ground and free from lumps or caking. Unless otherwise permitted, the cement shall be delivered in canvas bags or other strong, well-made packages, each plainly marked with the manufacturer's brand. The weights of such bags shall be uniform. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages. Cement shall be stored in a satisfactory manner so as to be unaffected by moisture, keeping each carload separate until the results of the 28-day tests are known. Suitable accurate scales shall be provided by the contractor for weighing the cement.

f. Records of cement used. - The contractor shall furnish to the contracting officer, at the end of each day's work, a statement showing in such detail as he may reasonably require the quantity of cement used during the day at each part of the work.

11-06. Fine aggregate. - a. Composition. - Fine aggregate shall be natural sand.

b. Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

c. Grading. - (1) Except as provided in (2) below fine aggregate shall conform to the following requirements:

Total passing -	Per cent by weight
No. 4 sieve	95 - 100
No. 16 sieve	45 - 75
No. 50 sieve	10 - 25
No. 100 sieve	1.5 to 7

(2) Deficiencies in the percentages of fine aggregate passing #50 and #100 sieves, as required in the above gradation, may be remedied by the addition of pozzuolanic or cementitious materials, excepting Portland cement; provided, at least 5 per cent passes the #50 sieve and the aggregate is of proper consistent gradation within the specified limits. Such added material, which will be considered and included as fine aggregate, shall conform to the requirements in Paragraph 11-08 and shall be in sufficient quantity to meet the minimum requirements above for percentage passing #100 sieve and otherwise to produce the workability required by the contracting officer. The quantity and characteristics of any material used for the purpose of correcting workability shall be such that when the concrete is gaged to the proper consistency the total water content shall not exceed by more than 1 gallon per cubic yard the minimum quantity required for proper consistency when not using the admixture. The blending of any material with the original naturally graded sand to remedy deficiency in gradation shall be accomplished in charging the mixture, unless otherwise specifically authorized by the contracting officer.

d. Deleterious substances. - The substances designated shall not be present in excess of the following amounts:

	Per cent by weight
Mica	0.5
Clay lumps	1
Material removed by decantation from aggregates not more than	3
Shale	0.5

e. Mortar strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 per cent of the strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40+ 0.10 and the same cement.

f. Tests. - Fine aggregate shall be subject to careful, thorough analyses, including magnesium sulphate soundness tests (see Paragraph 11-07 d), to determine conformity with all requirements of these specifications.

11-07. Coarse aggregate. a. Composition. - Coarse aggregate shall be washed gravel or crushed stone.

b. Quality. - Coarse aggregate shall consist of hard, tough and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. The substances designated shall not be present in excess of the following amounts (by weight):

Soft fragments	5%
Clay lumps	1 1/4%
Removed by decantation	1%

When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised by 1-1/2 per cent. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration, shall not be used. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

c. Size. - (1) Coarse aggregate shall be well graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete, required for Item 37, the maximum size mesh screen for the aggregate shall be not less than 3/4 inch nor more than 2 inches.

For Class "B" concrete, required for Item 38, the maximum size mesh screen for the aggregate shall be not less than 1 inch nor more than 3 inches, unless otherwise specified.

(2) When the maximum size mesh screen is greater than 1 inch, the aggregate shall be separated, and the specified sizes delivered separately to individual proportioning hoppers, in accordance with the following:

For Maximum Size Mesh Screen, 1 in. to 2 in. inclusive:

- (1) No. 4 to 1/2 maximum size mesh screen, inclusive.
- (2) Over 1/2 maximum size to and including full maximum size mesh screen.

For Maximum Size Mesh Screen Greater than 2 in.:

- (1) No. 4 to 1 inch maximum size mesh screen, inclusive.
- (2) Over 1 inch maximum size to and including 1/2 maximum size mesh screen.
- (3) Over 1/2 maximum size to and including full maximum size mesh screen.

Within any of the above-indicated size-limits, not less than 85 per cent of the material shall be retained on a standard square mesh screen of the minimum size indicated and not more than 5 per cent shall be retained on a standard square mesh screen of the maximum size indicated.

(3) The grading of the coarse aggregate, in the mixed concrete, shall fall within the following limits:

(Per cent by weight)

Passing

Maximum size mesh screen (square mesh)	97 - 100
1/2 maximum size mesh screen (square mesh)	40 - 70
No. 4 sieve	0 - 6

d. Tests. - Coarse aggregate will be subjected to freezing and thawing tests and to careful, thorough analyses to determine conformity with all requirements of these specifications. Coarse aggregate will be subjected to 10 cycles of the magnesium sulphate test for soundness. No aggregate shall be used which develops a loss in excess of 10 per cent by weight.

11-08. Material added for workability. - a. The use of any material added to the mix to improve workability (see Paragraph 11-06 c (2)), which, in the opinion of the contracting officer, may have an injurious effect on the strength, density, and durability of the concrete, will not be permitted. Before approval of any material, the contractor will be required to submit the results of complete chemical and sieve analyses made by an acceptable testing laboratory. Subsequent tests will be made of samples taken by the contracting officer from the supply of the material being used on the work to determine whether it is uniform in quality with that approved.

b. The material added shall be pozzuolanic, cementitious or silicious. It shall not contain effective early-heat-producing elements nor compounds, such as those contained in Portland cement, nor shall its use result in a material increase in the free-lime content of the concrete. It shall also be in conformity with the following requirements:

Free moisture - a total of not more than 3 per cent by weight.

Passing #30 sieve - not less than 100 per cent by weight.

Passing #200 sieve - not less than 85 per cent by weight.

11-09. Water. - The water used in mixing concrete shall be fresh, clean and free from injurious amounts of oil, acid, alkali, or organic matter.

11-10. Storage. - a. Cement. - Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weather-tight, and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. The building shall be of adequate capacity to provide for the requirements of delivery and construction schedules. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

b. Aggregates. - The fine and coarse aggregates shall be stored separately (see Paragraph 11-07 c (2)) and in such manner as to avoid the inclusion of any foreign material in the concrete. Stock-piles of coarse aggregates shall be built in horizontal layers to avoid

segregation.

11-11. Sampling and testing aggregates. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be taken under the supervision of the contracting officer and supplied to the Central Concrete Laboratory, West Point, N. Y., by the contractor at his expense. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they will be required in the work, and suitable samples as they are to be used in the concrete shall be furnished to the contracting officer at least 30 days in advance of the time when the placing of the concrete is expected to begin. The contractor shall obtain fine and coarse aggregates for concrete from approved commercial sources.

PROPORTIONING, MIXING AND PLACING

11-12. Proportioning. - a. Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

b. Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions will be changed whenever in the opinion of the contracting officer such change becomes necessary to obtain the specified strength and the desired density, uniformity and workability, and the contractor will not be compensated because of such changes.

c. Measurement. - All materials shall be measured by weight except that water may be measured by volume when so authorized by the contracting officer. One bag of cement will be considered as 94 pounds in weight and 1 gallon of water as 8.33 pounds.

d. Cement content. - Each cubic yard of concrete shall contain not less than the quantity of cement stated below:

Class "A" - 5.5 bags or 517 pounds.

Class "B" - 4.5 bags or 423 pounds.

For concrete deposited in water the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete in place.

e. Water content. - (1) In calculating the total water content in any mix the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content for a bag of cement for each batch of concrete shall not exceed the following:

Class "A" - 5.5 gallons or 45.8 pounds.

Class "B" - 6.5 gallons or 54.1 pounds.

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1 inch and 3 inches when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete", of the American Society for Testing Materials.

(2) An increase in the maximum water content, based only on the requirements of materials added in accordance with Paragraph 11-06 c to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water content will not result in a decrease in concrete strength and provided further that such increase does not exceed 1 gallon per cubic yard.

f. Aggregate content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer.

11-13. Mixing and placing. - a. Equipment. - Concrete shall be mixed in approved mechanical mixers of a rotating drum type, except that if permitted relatively small quantities may be mixed by hand in a satisfactory manner. Concrete shall be mixed at all times by competent and experienced men. The contractor shall provide at the site of the work a modern and dependable batch type mixing plant with a minimum capacity of 150 cubic yards of concrete per 8 hours. The plant shall include not fewer than two complete mixers with separate power plants, having a minimum capacity of $3/4$ cubic yards each. The equipment shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The complete plant assembly, including provisions to facilitate the inspection of all operations at all times and the adequacy and dependability of each of its parts shall be subject to the approval of the contracting officer and shall conform to the following requirements:

(1) It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

(2) It shall be capable of controlling the delivery of all material within 1 per cent by weight of the specified amounts.

(3) It shall be arranged to permit the convenient removal of the material in excess of the specified tolerances.

(4) It shall include a visible dial or any suitable device which will accurately register the scale load at any stage of the weighing operations from zero to full capacity.

(5) The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards and shall be tested monthly or otherwise when required at the expense of the contractor.

(6) It shall include a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanisms must be such that no leakage will occur when the valves are closed.

(7) It shall include a device for accurately and automatically measuring and indicating the time required for mixing, which may be interlocked to prevent the discharge of concrete from the mixer before the end of the mixing period.

(8) It shall include a device for properly recording and indicating the number of batches handled.

b. Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

3/4 to 1-1/2 cu. yd. mixer	1-1/2 minutes
Larger than 1-1/2 cu. yd. mixer	2 minutes

The mixer shall revolve a minimum of 12 revolutions after all materials have been placed in it, and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

c. Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Conveying of concrete by means of chutes will not be permitted except for short chutes in the forms to distribute the concrete. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted. There shall be no free vertical drop greater than 5 feet except where specifically authorized by the contracting officer.

d. Placing. - (1) Concrete shall be placed before initial set has occurred, and in no event after it has contained its water content for more than 45 minutes.

(2) Unless otherwise specified, all concrete shall be placed in the dry upon clean, damp surfaces, free from ice, frost or running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling, puddling or tamping so that ultimate settlement has occurred.

(3) Rock surfaces upon which concrete is placed shall

be approximately horizontal or stepped, rough, and free from loose material or other matter interfering with a satisfactory bond. The rock shall be washed, scrubbed with steel brushes or brooms, and spread with a layer of mortar about 1/2 inch thick, immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(4) Unless otherwise specifically authorized or directed, concrete in mass structures shall be placed in monoliths not exceeding 40 feet in length or width. The layout of all monoliths shall be as directed or approved by the contracting officer before concreting is commenced.

(5) All concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness unless otherwise specifically authorized or directed by the contracting officer and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Unless otherwise shown on the drawings, courses shall generally have a minimum thickness of 4 feet, and a maximum of 18 feet, except that in hot weather the contracting officer may direct the maximum be reduced to 8 feet. A minimum time interval of 48 hours shall be allowed between successive courses for the dissipation of heat of hydration. In walls of buildings, courses including door or window openings shall terminate at the tops of the openings.

(6) Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer. Vibration shall be transmitted directly to the concrete, and in no case shall it be transmitted through the forms. The frequency of vibration shall be not less than 5000 per minute. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. The vibration shall be of sufficient duration to accomplish thorough compaction as approved by the contracting officer. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see Paragraph 11-15).

e. Construction joints. - Vertical joints shall be formed

with tongue-and-groove bonds or keys at such locations and of such shapes and dimensions as approved or directed by the contracting officer (see Paragraph 12-01 b). Horizontal joints shall be formed with roughened level joints or with keys, or, where horizontal pressure is always in one direction, with steps as approved or directed by the contracting officer. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed. As soon as practicable after placing and immediately before placing the succeeding layers is resumed, all approximately horizontal surfaces shall be washed with a high pressure air-and-water jet, or cleaned as otherwise directed by the contracting officer. Sand shall be added to the air-and-water jet when required, to remove alkali, algae, stains, and other substances injurious to the bond. The time and method of using the jet shall be such that all laitance, scum, etc. will be removed so the partly embedded aggregate is not disturbed and is washed clean. After final cleaning and immediately after placing is resumed, the surfaces shall be wetted and spread with a layer of mortar 1/2 inch thick, thoroughly brushed in. The mortar shall be the same cement-sand ratio as the concrete. Where specified or otherwise required by the contracting officer for watertight construction, copper strips not less than 18 inches in width and weighing not less than 20 ounces per square foot, properly crimped or bent, shall be placed in the concrete to span the joint.

f. In water. - When specifically authorized, concrete may be deposited in water having a temperature above 45 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump-bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the top of the concrete is well above the water surface.

g. Cold weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F., nor when the concrete is likely to be subject to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in order that the temperature of the concrete, when deposited, shall be not less than 50 degrees F. nor more than 70 degrees F. All methods and equipment for heating shall be subject to the approval of the contracting officer.

h. Hot weather. - For concrete placed during the extremely

warm summer months and otherwise, when directed by the contracting officer, the aggregates shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. During such periods the placement schedule shall be arranged as approved by the contracting officer in such manner as to provide time for the temperature of the previously placed course to begin to recede. The mixing water shall be the coolest available at the site insofar as is practicable.

11-14. Test specimens. - a. Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in Paragraph 11-03, will be taken by the inspector. At least 1 set of 3 specimens will be made for every major pour and in general for every 200 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

b. Method. - All specimens will be taken from the concrete at the mixing plant. The specimens will be tested by the Government at the Central Concrete Laboratory, West Point, N. Y. All costs of transportation and testing of specimens will be borne by the Government.

11-15. Finishing. - Immediately after placement, the concrete shall be properly forked back along the face of all forms by the use of standard concrete forks or spades unless otherwise specifically authorized or directed by the contracting officer. The finished surfaces shall be free from sand streaks or other voids and the plastering over of such surfaces will not be permitted. Defective concrete shall be repaired by cutting out the unsatisfactory material to a depth of not less than 2 inches, and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely to the other work. One anchor shall be placed for each 64 square inches of area and the sides of the cut areas shall be generally rectangular. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place behind forms securely fastened. Unless otherwise specified, all surfaces of concrete not covered by forms, that are not to be covered by additional concrete, or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the contracting officer.

11-16. Curing. - a. Warm weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All con-

crete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering, or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which in the opinion of the contracting officer might cause staining or discoloration of the concrete.

b. Cold weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days of the curing period. For massive sections, where the atmospheric temperatures are sufficiently low in the opinion of the contracting officer to cause excessively rapid cooling and contraction of the exterior surfaces, this period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. shall extend over the entire curing period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing except with the approval of the contracting officer.

FORMS, REINFORCEMENT AND PAYMENT

11-17. Forms. - a. Materials. - Forms shall be of wood, steel or other approved material, except that where lining is not specified, the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the contracting officer.

b. Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will be not less than 2 inches from any concrete surfaces. Wire ties will not be permitted where the concrete surface will be exposed to weathering and discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints or any other points as may be required by the contracting officer.

c. Coating. - Forms for exposed surfaces shall be coated

with a non-staining mineral oil which shall be applied before the concrete is placed. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

d. Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

Arches, beams and slabs	14 days
Columns	7 days
Walls and vertical faces	2 days

e. Form lining. - In addition to the requirement for work specified above, wood forms for walls which will be visible in the finished structure and at other locations indicated on the drawings or as directed by the contracting officer, shall be lined with sheet steel, plywood, or with pressed wood sheets similar to Masonite or approved equal. Lining shall be applied directly to the sheeting. Forms for window and door jambs and their flat or arched soffits shall be lined and the corner intersections chamfered. The jointing of the lining shall be neat and close and no patch pieces, plugs, cleats or blocking will be permitted. Overrun of lining shall be trimmed to secure proper fit to adjoining surfaces. Lining with bruises, imprints or hammer marks shall not be used.

11-18. Furnishing, bending, and placing steel reinforcement (Item 39). - a. Work included. - (1) The contractor shall furnish, cut, bend and build into the concrete, in accordance with the drawings and directions, all reinforcing steel of deformed bars, dowels or anchors, steel plates for water stops across contraction joints, if any, or any other plain steel for similar purposes.

(2) Steel reinforcement may be cut and bent at the mill or in the field. All bending shall be in accordance with standard approved practice and by approved machine methods.

b. Materials. - (1) Reinforcing steel shall be of new, billet intermediate grade, open-hearth steel, deformed, and shall conform to the Federal Specifications QQ-B-71a for "Bars, reinforcement, concrete, Type "B", Grade 2 (dated January 12, 1938)". Certified copies of any mill test required shall be furnished by the contractor and the steel shall be subjected to such tests as the contracting officer may consider necessary to establish its quality, including particularly the requirements of bending and elongation. The steel shall be free from oil, paint, dirt or excessive rust.

(2) Expanded metal reinforcement may be used as an alternate for horizontal reinforcement only in walls. This reinforcement shall consist of a diamond shaped steel mesh manufactured from open-hearth steel, by a cold drawn process which will cut and draw the material so that uniform strands are formed at regular intervals along the length of the sheet with the plate intact between successive strands. It shall possess ductile properties which will permit any strands to be bent through an angle of 180° over one diameter, without fracture, and to have a yield point of not less than 55,000 pounds per square inch. The size of the diamond shall be approximately 3 inches by 8 inches, and the effective cross-sectional area shall be not less than 0.30 square inches per foot of width, similar or equal to Style No. 3-9-30, as manufactured by The Consolidated Expanded Metal Companies, Wheeling, W. Va.

c. Placing. - (1) All steel reinforcement shall be placed in the exact positions and with the spacing shown on the drawings or ordered, and it shall be so fastened in position as to prevent its becoming displaced during the placing of the concrete. The clear distance between parallel rods shall be not less than one and one-half times the diameter of round rods, or twice the side dimensions of square rods, and unless specifically authorized, shall in no case be less than 1 inch.

(2) Except where otherwise indicated, reinforcement shall be placed as follows:

(a) All main reinforcement shall be placed not less than 4 inches from any surface, except in slabs and in buildings.

(b) All main reinforcement in walls, in slabs or buildings exposed to the weather and in fire-resistant construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1-1/2 inches in floor beams and 2 inches in girders and columns. The covering of stirrups, spacer rods, and similar secondary reinforcement may be reduced by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(c) Where splices in reinforcement, in addition to those indicated are necessary, there shall be sufficient lap to transfer the stress by bond as may be directed. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of rod. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together.

d. Protection. - Steel for reinforcement shall be new un-rusted stock, free from loose scale. It shall be at all times satisfactorily protected from moisture until placed in final position. Ends of rods that are to be left projecting for a considerable time shall be protected from corrosion by heavy wrapping of burlap saturated with bituminous material.

11-19. Embedded items. - a. General. - In addition to reinforcing steel, there shall be built into, or set, or attached to the concrete, gates, pipes, catch-basin and manhole frames and covers, and other metal objects as shown on the drawings or ordered. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. The concrete shall be packed tightly around pipes and other metal work so as to prevent leakage and secure perfect adhesion. Drains shall be adequately protected from intrusion of concrete into them. Payment for this work is included in the several items for drains and metal work.

b. Sheet metal sockets. - Where pipe-handrailings are shown on the drawings, sockets of thin sheet metal shall be placed in position as indicated. The cost of furnishing and installing these sockets will be covered by the contract price for concrete in which the sockets are placed.

11-20. Expansion and contraction joints. - Expansion and contraction joints shall be constructed at such points and of such dimensions as may be indicated or required. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to Federal Specifications wherever applicable. Unless otherwise indicated on the drawings, or required by the contracting officer, expansion joints shall be made by coating concrete surfaces with two coats of approved asphaltic emulsion or a single coat of bituminous cement to which premoulded sponge rubber or compressed cork filler 1/2" thick shall be applied and such filler thoroughly covered with asphaltic emulsion or bituminous cement. In no case shall corner protection angles or other fixed metal embedded in the surface of the concrete and bonded, be continuous through an expansion joint.

11-21. Measurement and payment. - a. Portland cement (Item 36). - (1) The quantity to be paid for under Item 36 will be the number of barrels of cement used in all parts of the work unless specifically excepted. For purposes of payment, a barrel of cement shall be considered 376 pounds net of cement. The unit contract price for the cement shall include payment for all expenses incidental to delivering the cement upon the work in which it is to be used.

(2) All cement furnished for concrete work to be done under the contract will be paid for under Item 36, but the cement used for mortar and grout in pipe joints and other features will be included in the payment for such pipe work and other features.

b. Concrete (Items 37 and 38). - See Section XII.

c. Reinforcement (Item 39). - (1) The contractor will be supplied with detail drawings and bending schedules of steel reinforcement by the Government.

(2) The quantity to be paid for under Item 39 will be the number of pounds of steel placed in accordance with the drawings or as directed by the contracting officer, measured as specified. It will not include any waste material due to the fact that the lengths supplied are too long for their purpose. The quantity to be paid for will, however, include extra metal in laps, where authorized, due to the fact that single bars would be unreasonably long. In computing the weights, the theoretical weight of plain bars will be used as tabulated in Federal Specifications QQ-B-71a for the lengths placed as required. For expanded metal reinforcement of the type specified, one square foot shall be assumed to weigh 1.02 pounds. Wire or metal clips, and other supports necessary to hold the steel in place will not be considered as reinforcement but shall be furnished by the contractor without additional compensation. The unit contract price for Item 39 shall include the furnishing, bending, cutting, placing, fastening in position, coating and protecting the reinforcement, and all other work and materials connected therewith. (See Paragraph 11-18 a).

SECTION XII. CONCRETE STRUCTURES (Items 37 and 38.)

12-01. General. - a. Description. - Concrete structures shall be constructed as shown on the drawings or in accordance with modifications designated by the contracting officer. Concrete shall conform to all requirements of Section XI for concrete of the class specified. Surfaces of concrete shall be finished as specified in Paragraph 11-15, except as otherwise specified in this section or indicated on the drawings.

b. The stems of the concrete wall sections need not be poured in one pour when the distances between expansion joints exceed 30 feet. In such cases a vertical construction joint with the steel passing through it shall be provided approximately at the center of the section.

c. Measurement and payment. - (1) The quantity to be paid for under Items 37 and 38, will be the number of cubic yards of concrete satisfactorily placed within the required limits. No deductions shall be made for openings having a cross-sectional area less than that of a 12-inch pipe, nor for the space occupied by reinforcing steel, miscellaneous metal, wood nailing strips, or by other materials required to be built into the concrete. The unit contract prices shall include payment for all costs of furnishing materials, erecting and removing forms, mixing and placing concrete and furnishing and installing expansion joint material except that cement, reinforcing steel and other metal work are included under other items. (See Paragraph 11-21).

(2) Additional payment will be made to the contractor for any replacement of concrete damaged by overtopping of cofferdams as provided in Paragraph 3-02b. The additional payment allowed for ordered replacement of damaged concrete will be at the respective contract prices stipulated for the items of work required. Any ordered excavation of damaged concrete preliminary to its replacement will be paid for at the contract unit price for rock excavation under Item 8. The quantities to be paid for will be the number of cubic yards for the items of work measured within the limits of repair work which the contracting officer may direct.

12-02. Class "A" concrete (Item 37). - a. Description. - This classification includes the Class "A" concrete, with 2-inch maximum size aggregate, for the flood wall, outlet, pumping station, gate, stop-log, and miscellaneous structures, placed between the limiting lines and grades as shown on the drawings or directed by the contracting officer. Forms for surfaces exposed to view shall be lined with plywood or pressed wood, "Masonite" or equal. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. Pipe drains and miscellaneous metal work shall be installed as provided for on the drawings. Any grouting of metal work shall be included as part of the concrete.

b. Measurement and payment. - The volume of concrete to be

paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer. The computed volume will be the net volume of concrete placed to the ordered lines and grades, including the net volume in columns, walls, floors and beams. Payment will be made at the contract unit price for Item 37, "Concrete Class "A".

12-03. Class "B" concrete (Item 38). - a. Description. - This classification includes the Class "B" concrete for footings, and miscellaneous structures in the required locations, as shown on the drawings or directed by the contracting officer. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. Piping and miscellaneous metal work shall be set and concreted in place as provided for on the drawings.

b. Measurement and payment. - The volume of concrete to be paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer. Payment will be made at the contract unit price for Item 38, "Concrete Class "B".

SECTION XIII. PUMPING STATION FEATURES (Item 40).

13-01. Pumping station features. - The contractor shall furnish all labor, equipment and materials, except the plaque furnished by the Government (see Paragraph 13-07b), and shall complete, in accordance with the specifications and the drawings, four (4) pumping station superstructures. Item 40 shall include all work incidental to the construction of the pump houses above the elevation of the operating floor except the furnishing and installation of such equipment as is specifically included in other items of the contract and the concrete work which will be paid for under Items 36, 37, and 39. The work includes glass-block masonry, doors, door frames, louvers, builders' hardware, roofing, painting and other work included in the construction of the pump house superstructures.

13-02. Glass block. - a. Glass block panels shall be installed as shown on the drawings. The blocks shall have a light transmission of not less than 83 per cent of the incident light. The glass block shall be hollow, partially evacuated, water clear units of pressed glass construction of the best quality, similar and equal to Series No. 200 of the Owens-Illinois Glass Company, Toledo, Ohio. Unless otherwise shown on the drawings all glass block shall have a standard size of $5\text{-}3/4$ by $5\text{-}3/4$ by $3\text{-}7/8$ inches. The design of the block shall consist of $1/4$ inch convex ribs carried vertically on both of the exterior faces; both of the interior faces shall be smooth. A sample of the type of glass block the contractor proposes to furnish shall be submitted for the approval of the contracting officer.

b. Laying of block. - (1) Each block shall be set in a $3/16$ -inch to $1/4$ -inch layer of mortar composed of one part Portland cement, one part lime, and four parts sand by volume. The sand used in the mortar shall conform in quality to that specified for concrete and the maximum size shall not exceed that passing a No. 8 standard mesh screen. Glass blocks shall be laid true to line and grade with exterior ribs running vertically. Both head and bed joints shall be completely filled with mortar; after the mortar has reached its initial set, the joints on both surfaces shall be compressed and pointed with a metal pointing tool, leaving the finished surface of the joint smooth and non-porous. Blocks shall not be cleaned until after mortar has reached its final set.

(2) Horizontal mortar joints shall be reinforced with 20-gauge perforated metal wall ties $1\text{-}3/4$ inches wide and of a length suitable for the glass block panel, galvanized after forming. Ties shall run continuously by lapping 6 inches at ends; they shall be placed every third course and shall extend 15 inches into adjacent masonry for anchorage.

(3) Expansion joints shall be provided at the head and jambs of all glass-block panels, and all joints at head and jamb

of panels shall be kept free from mortar and free from the transmission of structural loads carried by adjacent masonry. Expansion joints shall have a width of 1/4-inch to 1/2-inch, and shall consist of a core of oakum, packed so as to be resilient and pointed with not less than 1/2-inch of non-hardening waterproof calking material similar and equal to "Vulcatex" manufactured by A. C. Horn Co., Long Island City, New York, or other approved elastic (or mastic) compound as shown on the drawings.

13-03. Doors. - a. Doors shall be of the type and design shown on the drawings. All doors shall be of the double, vertical, swinging type and shall be supported at the jamb with butts as shown on the drawings. Stiles and rails shall be constructed of 5 by 1-3/4 inch 14-gauge pressed steel tube. All mitre joints and butt joints shall be welded and ground smooth. The metals in the panels shall be not less than 18-gauge in thickness. Doors shall be provided with a pressed steel door frame made of 14-gauge steel and the frame shall be supplied by the door manufacturer. The quality of the material, the type of door and the workmanship shall in all respects be similar and equal to Industrial Steel Doors Series 31, Truscon Steel Co., Youngstown, Ohio. The door sill shall be brass with a fluted top and shall be similar and equal to No. 62 of the Protex Weatherstrip Mfg. Co., Chicago, Illinois.

b. The door shall be painted and finished in the color to be selected by the contracting officer after it has been placed in final location.

c. The payment for the door installed and the brass door sill will be included in the lump sum bid for Item No. 40.

13-04. Louvers. - Where shown on the plans, louvers of the size indicated, will be placed. The frame of these louvers shall be of 32-ounce and the blades of 48-ounce cold rolled copper mounted on bronze bearings. The louver frames shall be constructed in such a manner so as to assure a water-tight connection between the frame and the wall. They shall be equipped on the exterior with copper mesh screens of the size and type made by the same manufacturer who furnishes the louvers. The louvers shall be similar and equal to those manufactured by the H. H. W. Borgmann & Co., New York, New York.

13-05. Builders' Hardware. - a. The contractor shall furnish and install bronze hardware for all doors, including locksets, butts, floor and wall bumpers, clamps and all other details of a complete installation.

b. The hardware shall be secured in place with machine screws and reinforcing plates shall be provided where necessary. Grouting around the foot bolt keepers in the floor shall be brought flush with the top. The hardware shall be subject to the approval of

the contracting officer, shall be of the solid bronze type, and of sufficient strength and size for the use intended. It shall conform to Federal Specifications, FF-H Series, where applicable, and shall be similar and equal to the following products of the P. F. Corbin Company and the Stanley Company.

Butts	Stanley BB 199 (6x6)
Foot bolts	Corbin BB 4250-1/2-8"
Chain bolts	Corbin BB 4252-1/2-8"
Lock	Corbin BB 742-991

13-06. Roofing. - a. Deck. - The concrete roof slab shall be covered with a built-up gravel roof as follows: Before the application of any roofing material, the concrete slab shall be smooth, clean, firm, and dry. The entire surface of the slab shall then be coated uniformly with an approved asphalt primer, using not less than one gallon of primer for each 100 square feet of roof surface. Not less than 24 hours after the application of the priming coat, the entire surface shall be coated uniformly with hot asphalt conforming to Federal Specification SS-A-666 for Asphalt for Built-Up Roofing. Into this coating, while hot, there shall be laid four layers of 15-pound, 36-inch asphalt-saturated felt over the entire surface of the roof, lapping each sheet 27-1/2 inches over the preceding one, lapping the ends not less than 6 inches, and mopping with asphalt the full 27-1/2 inches so that in no place shall felt touch felt. The felt shall conform to Federal Specifications HH-F-191 for Asphalt-Saturated Felt. At all vertical surfaces the roofing shall be carried up at least 6 inches and thoroughly mopped to the wall so that contact is obtained throughout, and flashed as indicated on the drawings (see Paragraph 13-06b). The layers of felt shall be laid so as to be free from wrinkles and buckles. Over the entire surface there shall be poured from a dipper a uniform coating of asphalt, into which, while hot, there shall be embedded not less than 400 pounds of gravel per 100 square feet. Not less than 160 pounds of asphalt shall be used in constructing each 100 square feet of the completed roof and the asphalt shall be applied at a temperature of approximately 350 degrees F. The roofing gravel shall be hard, durable, waterworn, dry, and free from clay, loam, sand, or other foreign substances. All gravel shall pass a 3/4-inch square mesh sieve, not less than 80 per cent shall pass a 5/8-inch square mesh sieve and shall be retained on a 1/4-inch square mesh sieve, and 100 per cent shall be retained on a No. 8 standard square mesh sieve.

b. Flashing. - All flashing, as indicated on the drawings or otherwise required, except where otherwise indicated, shall be 20-ounce copper, conforming in all respects to Federal Specifications QQ-C-501, Type V, Class "A". Seams shall be flat locked with 5/8-inch finish, and proper provision made for expansion.

13-07. Miscellaneous details. - a. The contractor shall furnish

and install under Item 40, the bronze letters of the design and in the locations shown on the drawings.

b. The contractor shall install under Item 40, at the location shown on the drawings the plaque which will be furnished by the Government.

13-08. Painting. - The floors of the pumping stations and the side walls to a height of 4 feet above the floor shall be painted with one priming coat and two finish coats of concrete paint as approved by the contracting officer. A dado of a contrasting color shall be painted around the side walls. The cost of all painting shall be included in the lump sum contract price bid for Item 40 (see Paragraph 13-09).

13-09. Payment. - Payment for constructing and completing the pump house superstructure in accordance with the specifications and the drawings will be made at the contract lump sum price for Item 40, "Pumping Station Features," except the furnishing and installation of such equipment as is specifically included in other items of the contract and the concrete work which will be paid for at the applicable unit price for Items 36, 37, and 39.

SECTION XIV. FLOOD GATES, COMPLETE WITH HOISTS AND ACCESSORIES
(Items 41 and 42).

14-01. Classification. - The work shall be classified as follows:

a. Structural Steel Flood Gates, complete with guides and seals, Item 41 (see Paragraph 14-02).

b. Hoists for Flood Gates, complete with hoist supports, stems and stem guides, Item 42 (see Paragraph 14-03).

14-02. Structural steel flood gates (Item 41). - a. Work included. - The contractor shall furnish and install the 16 structural steel gates as shown on the drawings, in their locations at the respective tailrace outlets as shown on the drawings, including gate frames, guides, rolls, seals and all other parts and accessories required for the complete gate installations.

b. Description. - Each gate shall be rectangular in shape and shall be constructed of structural steel members as indicated on the drawings to form a water-tight structure. Each gate shall consist of gate frame made up of horizontal wide flange beams, top and bottom channels, angles, side plate, skin plate, bronze seals, and cold rolled steel rollers as shown on the drawings. The roller bushings shall be of bronze and shall be similar and equal to Lubrite, self-lubricating bearings. In addition the gate shall be provided with hanging lugs for suspending the gate below the top of the outlet structure in order that the gate can be disconnected from the hoist stems and the hoist moved from its position over the gate recess. Each gate assembly shall consist of gate, seal plates, guides, and accessories for operation or other purposes as shown on the drawings.

c. Guides. - The guides shall be constructed of structural steel, consisting of ship channels rectangular plates and anchors as shown on the drawings. The guides shall be provided with backing plates for the purpose of securing necessary thread depth for the seal and cap screws. The construction of the plates and method of attaching shall be as shown on the drawings. A sill plate shall be provided and shall be attached to the lower seal channel and shall serve as a resting plate for the gate when it is in its closed position.

d. Seals. - The gate seals shall be Class C bronze and shall be attached to the gates as shown on the drawings. The guide seals shall be Class D bronze and shall be attached to the guides as shown on the drawings. (See Paragraph 17-02a (18)).

e. Drawings. - The drawings show the general design and arrangements of the apparatus, together with the dimensions of the principal parts. The contractor shall carefully check the drawings and notify the contracting officer of any error or omission discovered.

The contractor shall, at his own expense, prepare all necessary shop drawings in accordance with Paragraph 1-04 c covering material to be furnished and installed, and shall be responsible for the correct fittings of all parts.

f. Materials. - (1) In general, the type of material to be used for each part is indicated on the drawings. Unless otherwise specified, all metals shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications (see Section XVII). Other materials, unless otherwise specified or shown on the drawings, shall conform to current standard practice for the material required and use intended.

(2) Whenever requested to do so, the contractor shall submit to the contracting officer certified copies of tests of all materials he proposes to use in the manufacture of the equipment. The results of these tests shall be in such form as to afford means of determining compliance with the applicable specifications for the material tested. The cost of making all the above-required tests shall be borne by the contractor. The contracting officer shall have the right to select, test, and analyze, at the expense of the Government, additional tests specimens of any or all of the materials to be used. The results of such tests and analyses shall be made to determine compliance with the applicable specifications for the materials tested.

g. Workmanship. - (1) General. - All work shall be done and completed in a thorough, workmanlike manner and shall follow the best modern practice in the manufacture of high-grade machinery, notwithstanding any omission from these specifications. All work shall be done by mechanics skilled in their various trades, and wherever possible all parts shall be made accurately to standard gauge to facilitate replacement and repair. Tolerances and clearances specified on the drawings shall be closely adhered to and the machine work shall in all cases be of high-grade workmanship and finish, carefully performed to the satisfaction of the contracting officer. Where tolerances or fits are not specified on the drawings, the contractor shall follow the best modern shop practice for equipment of the type to be furnished, due consideration being given to the special nature or function of the parts and to the corresponding accuracy required to secure proper operation.

(2) Machine finish. - Where finished surfaces are required or specified on the drawings, the type of finish where not otherwise specified shall be smooth, average, or rough as defined herein. Where a smooth finish is specified or required, the machine work shall be performed in such a manner as to produce smooth surfaces practically free from tool or chatter marks. Pronounced tool marks or other defects on such surfaces will be cause for rejection of the part. Where an average surface is specified or required, smooth surfaces shall be produced, but slight tool marks will be allowed. Where rough finish

is specified or required, rough machining sufficient only to produce a plane or turned surface true to dimensions will be allowed. In general a smooth finish will be required for all surfaces in sliding contact, an average finish for all surfaces in permanent contact where a tight joint is required, and a rough finish for all other machined surfaces.

(3) Fabrication. - All principal structural members shall be joined together by riveting. Welding shall be used at the locations indicated on the drawings and may be used for other minor connections as approved by the contracting officer. The fabrication of all structural steel shall conform to the requirements of the American Institute of Steel Construction Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings except as modified by these specifications or by the drawings.

(4) Bevel shearing and caulking. - All joints in the skin plate and all other joints that contribute to water tightness shall be caulked. Wherever applicable, caulking shall be done on the water face. The edges of all plates that require caulking shall be bevel-sheared. Bevel shearing or planing shall be done after punching. All caulking shall be done with a round-nose caulking tool and the caulking edge shall be drawn closely against the surface under the caulking edge before caulking is done. The surface under the caulking edge shall not be scored and the caulked member shall not be split.

h. Punching and Reaming. - Holes for all rivets shall be either sub-punched $1/8$ inch smaller than the nominal diameter of the rivet and reamed at assembly to the finished size $1/6$ inch larger than the nominal diameter of the rivet or drilled full size at assembly. After reaming, holes shall be clean-cut without torn or ragged edges and all outside burrs shall be removed with a tool, making a $1/16$ -inch fillet. Drifting to enlarge unfair holes will not be allowed. Poor matching of the holes will be cause for rejection.

i. Shop assembly. - After the gates are fabricated, each gate shall be completely and carefully assembled in the shop. Except as otherwise noted on the drawings all holes for field connections shall be reamed while the gates are thus assembled. Pin holes shall be bored to gages, smooth, straight, and at right angles to axis of member. The boring shall be done after member is securely fastened in position and riveted. Special care shall be exercised in drilling the hoisting angles to insure that the center lines of the holes in the angles will be directly in a vertical line with the center of gravity.

j. Marking. - All parts of each complete unit which is to be shipped disassembled, shall be marked and match-marked for identification and to facilitate field assembly and a diagram of such marking shall be forwarded by the contractor to the contracting officer.

Marks shall be permanent and shall be so placed as to be readily visible when the part is erected in the structure.

k. Installation. - The gates and accessories shall be assembled and installed complete and ready for operation, as indicated on the drawings and as directed by the contracting officer. The gate frames and guides shall be assembled in place in a manner satisfactory to the contracting officer. The assembled units shall be checked for alignment and elevation, and the structures substantially anchored in place. The concrete shall then be carefully placed around the frames and guides and brought to the specified line and grade. All bolts, jacks, special tools, and other devices necessary to erect the gates and accessories, and any special anchors required to secure the assembled parts while they are being concreted in place, shall be furnished at no additional cost to the Government.

l. Inspection and tests. - The work will be inspected during fabrication by authorized representatives of the contracting officer. After installation, each gate shall be tested for satisfactory operation by raising and lowering the gate several times for its full length of travel. Any adjustments in the setting or installation, or any other changes necessary to secure satisfactory operation and tight closure of the gates shall be made by the contractor. The cost of all testing, except for the Government's representative, shall be borne by the contractor and shall be included in the price bid for Item 41.

m. Painting. - (1) Preparation of surfaces. - After fabrication all unfinished iron and steel surfaces shall be prepared for painting by thoroughly cleaning the metal surfaces and removing all mill scale, dirt, grease, rust, and other foreign substances. The metal surfaces shall be cleaned with benzine and sandpaper, and wire brushes or sandblasting shall be used where necessary.

(2) Materials. - All paint materials shall conform to Federal Specifications of Group TT, where they are applicable.

(3) Application. - After cleaning, all unfinished iron and steel surfaces shall be given one shop coat of pure red lead paint, one touch-up field coat of red lead paint, and two finish coats of Detroit Graphite Underwater Black Metal Paint or equal. Painting shall be done only on surfaces that are thoroughly dry and clean. The work shall be done in a neat, thorough, and workmanlike manner, and in no case shall any paint be applied in freezing, rainy, or misty weather.

n. Measurement and payment. - The quantity to be paid for under Item 41 will be the number of pounds furnished and installed in accordance with the drawings and specifications. Wherever practicable, the quantity shall be determined by weighing the articles and

materials at the point of manufacture on the most accurate scales available, and will include the weight of all field rivets shipped. When weighing is not practicable, the actual weight of each part or item involved will be determined from the drawings by the contracting officer; provided, that no payment will be made for any weight in excess of 5 per cent more than the computed weight as determined from the drawings, which will include allowance for shop paint, rivet and bolt heads, with deductions for copes, cuts, and open holes.

14-03. Hoists for the flood gates. (Item 42) - a. - Work included.
The contractor shall furnish and install 16 pairs of hand-operated hoists, one pair for each gate as shown on the drawings, complete with stems, stem guides, stem pipe covers and bracing, accessories and position indicator.

b. Description. - (1) Each tailrace gate shall be operated by 2-hand operated hoists, each designed to lift on the low speed ratio not less than 11,000 pounds on a 2-3/4 inch stem when a force of 40 pounds is applied to the crank. The hoists shall be two speed units having a minimum stem rising and lowering speed of 3/4 inch per minute for the low speed ratio and 2 inches per minute for the high speed ratio when each crank is operated at 15 turns per minute.

(2) One hoist for each gate shall be furnished with a right-hand operating nut and stem and one with a left-hand operating nut and stem and the hoists shall be so connected that their stems will simultaneously rise and lower at the same rate of speed.

(3) The hoists for each gate shall be provided with a single crank and shall be connected together through couplings by a cold-rolled steel shaft of not less than 1 inch in diameter.

(4) The operating nut shall be of cast bronze supported above and below by ball or roller thrust bearings.

(5) All gears shall be of steel properly designed for the service intended. The gear shafts shall be provided with bronze bushings.

(6) The pedestal and gear case shall be made waterproof and shall be constructed of high grade cast iron with provisions made for attaching stem cover to top cover plate. A suitable torque plate shall be provided at the base of the pedestal.

(7) The structural steel hoist supports shall be constructed and anchored to the concrete as shown on the drawings.

(8) The stems shall be made of cold-rolled steel and shall be connected to the gates and through the hoist operating nut as shown on the drawings. Where they are made up of more than one

section they shall be joined together by manganese bronze couplings of an approved type. The stems shall be supported by guides where indicated on the drawings. The guides shall consist of brackets and guide bearings, both of which are adjustable to provide free movement of the stem.

(9) Stem covers of wrought iron pipe shall be provided and supported by structural steel bracing as shown on the drawings.

c. Drawings. - The contractor shall submit for approval detailed drawings of the hoists he proposes to furnish, together with an itemized list of parts, with the grade and class of material for a standard make article. The item number in the list of parts shall be shown on the drawings by means of a circle enclosing the item number and a solid light line connecting the circle to the part. Any item or part excluded from the drawings or the list of parts but needed in order to provide a complete and workable installation in accordance with the intent of these specifications, shall be supplied by the contractor, the same as if included on the drawings and list of parts or in the requirements of those specifications. These drawings shall have sufficient detail to thoroughly check the design.

d. Material and workmanship. - Each hoist shall be constructed of the grade and class of materials as shown on the drawings or List of Parts on the design drawings as furnished by the contractor and approved by the contracting officer and shall conform to the provisions of Section XVII where applicable. All metal workmanship shall be of approved standard quality.

e. Installation. - Two hoists with their accessories shall be attached to each tailrace gate and installed in their proper locations as shown on the drawings.

f. Inspection and tests. - Before shipment the hoists shall be completely assembled in the shop for inspection and test. After assembly, the parts of each complete mechanism shall be marked and match-marked for identification and to facilitate assembly in the field.

g. Marking. - All parts of each complete unit which is to be shipped disassembled, shall be marked and match-marked for identification and to facilitate field assembly and a diagram of such marking shall be forwarded to the contracting officer. Marks shall be permanent and shall be so placed as to be readily visible when the part is erected in the structure.

h. Painting. - There shall be applied to the hoists, one coat of metal filler, one shop coat of red lead plus touch-up coat (see Paragraph 15-12d), and two coats of selected engine enamel,

of a color approved by the contracting officer. The paint and painting shall be subject to the approval of the contracting officer.

i. Payment. - Payment under Item 42 shall include designing, constructing, furnishing, and installing the work included in Paragraph 11-03. Payment will be made at the contract price per pair of hoists under Item 42, "Furnishing and Installing Flood Gate Hoists."

SECTION XV. SLUICE GATES, COMPLETE WITH HOISTS AND ACCESSORIES (Item 43)

15-01. Work included. - The contractor shall design, furnish and install four hand-operated sluice gates, one at each of the four pumping stations as shown on the drawings, complete with hoists and accessories, all in accordance with the drawings and the specifications.

15-02. Description. - The gates shall be of cast iron with bronze seals, and shall be designed to operate satisfactorily under all heads up to and including the maximum hydrostatic head of 25 feet at the center of the gate opening. The dimensions of the gate opening shall be 4 feet in width and 5 feet in height, with the gate fully raised. Each gate shall be hand-operated by means of rising-stem hoist actuated by crank. Each gate shall seat or unseat satisfactorily under the maximum hydrostatic head with not more than a 40-pound pull on the hoist crank. When seated the gates shall be practically water-tight.

15-03. Gate details. - a. Each gate shall consist of a rectangular cast iron plate (or leaf) with horizontal and vertical ribs. The gate leaf shall be not less than 7/8-inch thick. The ribs shall be not less than 7/8-inch thick spaced not more than 12 inches center to center. Bronze seat facings shall be driven into dovetail grooves machined in the face of the gates.

b. The gate shall have a rising stem of sufficient size to withstand safely, without buckling, the whole thrust due to closing the gate under the maximum operating head. The gate stem shall be cold-rolled steel in sections not exceeding 12 feet in length. The sections of each stem shall be jointed together by solid manganese-bronze couplings threaded and keyed to the stems.

c. Each stem shall be furnished with stem guides so that the unsupported length of stem shall not exceed 12 feet. All stem guides shall be bronze-bushed and adjustable.

15-04. Frames and guides. - a. The gate frames shall be of the standard flat type having the rear face machined and drilled to attach to concrete and the front face machined to take the sluice gate guides. The frames shall be of cast iron of ample section to prevent distortion and shall be cast in one piece. Bronze seat facings shall be driven into dovetail grooves machined in the front face of the frame.

b. The guides shall be of cast iron of sufficient length so that not less than one-half of the gate is within the guides when the gate is fully open.

15-05. Hoists. - a. The gate hoists shall be two-speed units designed and built for hand operation of sluice gates, and shall be of sufficient capacity to raise or lower the gates against the maximum operating head with not more than a 40-pound pull on the crank. The

hoists shall be made of cast iron conforming to Federal Specification QQ-I-651.

b. The pedestal and gear cases shall be made of cast iron conforming to Federal Specification QQ-I-651. The operating nut shall be of cast bronze and all gears shall be of steel of sufficient strength and properly designed for the service required. Each hoist shall be equipped with two single row ball thrust bearings; one above and one below the operating nut. The gear shafts shall be provided with bronze bushings.

15-06. Furnishings and fittings. - a. The gate frames, guides and hoists shall be designed and constructed to provide a satisfactory method of fastening them securely to concrete or other supports during erection as shown on the drawings. All bolts, special tools and other devices necessary to erect the gates, frames, guides and hoists as shown on the drawings shall be furnished by the contractor.

b. All bolts, nuts, screws, studs, pins, etc., shall be securely locked by satisfactory devices that will prevent loosening due to vibration.

15-07. Design. - a. The detailed design for the sluice gates, hoists, and accessories shall be such that all working parts shall be readily accessible for inspection and repair, easily duplicated and readily replaced. Each and every part of the equipment shall be properly designed and suitable for the use and service required.

b. The design stress for any member or part of the material covered by these specifications shall not be greater than one-fifth of the ultimate strength of the material used.

15-08. Drawings. - The contractor shall submit for approval design computations and detail drawings for the sluice gates, hoists and accessories he proposes to install in sufficient detail to check the design. These drawings shall be in accordance with Paragraph 1-04c and shall include a complete and itemized list of all parts, with the grade and class of material or make of a standard article, the contractor proposes to furnish. The item number in the list of parts shall be shown on the drawings by means of a circle enclosing the item number and a solid light line connecting the circle to the part. Proposed construction shall be clearly shown on the drawings by the liberal use of sections, enlarged details and by other means. Any item or part omitted from the drawings or list of parts but needed to comply with the requirements of these specifications or any item or part omitted from the drawings or the list of parts and also omitted from the requirements of these specifications, but needed in order to provide a complete and workable installation in accordance with the intent of these specifications, shall be supplied by the contractor the same as if included on the drawings, the list of parts, or in the re-

quirements of these specifications. Approved drawings submitted by the contractor shall become a part of these specifications.

15-09. Materials and workmanship. - Each gate, with its hoist and accessories, shall be constructed of the grade and class of materials as shown on the "List of Parts" on the design drawings as furnished by the contractor and approved by the contracting officer and shall conform to the provisions of Section XVII, where applicable. All metal workmanship shall be of approved standard quality.

15-10. Installation. - The gates shall be completely assembled during installation and the leaf shall be screwed lightly into its seat and shall be held in place by jack screws. Care shall be exercised when drawing the frame up to the concrete to insure its being pulled against a true surface. All bolts shall be tightened carefully so as not to strain or warp the parts and to preserve proper alignment. Grout shall be poured between the face of the flange and the concrete to prevent any tendency to spring the frame. After installation the jack screws shall be removed and discarded.

15-11. Inspection and tests. - a. The gates, hoists and accessories to be furnished shall be assembled in the shop as directed by the contracting officer for inspection and to insure that all parts fit accurately and are in proper alignment. Each gate shall be opened and closed to insure proper operation.

b. After completion of the pumping stations and the installation of all machinery, each gate shall be tested for satisfactory operation by being raised and lowered several times for its full length of travel. Any adjustments in the setting or installation required to secure satisfactory operation and tight closure of the gates shall be made by the contractor. The gate hoists shall be tested as directed and any adjustments or changes that may be required in the opinion of the contracting officer shall be done by the contractor.

c. The cost of all testing shall be borne by the contractor, except for the Government's representatives, and shall be included in the contract price for Item 43.

15-12. Painting. - a. Painting shall conform to the applicable provisions of Paragraph 14-02 m.

b. For gates and gate guides there shall be one coat of metal filler, one shop coat of red lead and one field coat of red lead paint orange in color and two finish coats of graphite paint. Painting shall be similar or equal to Detroit Graphite Company's Iron-Gard System for underwater steel structures.

c. For gate hoists there shall be applied one coat of metal filler, one shop coat of red lead, one field touch-up coat of

red lead, and two coats of selected engine enamel.

d. The touch-up coat shall be applied as may appear necessary to The contracting officer and shall be done with the same shade as the shop coat.

15-13. Payment. - Payment for designing, furnishing, painting and installing the work included in Paragraph 15-01 will be made at the contract unit price for Item 43.

SECTION XVI. TRAVELING CRANES, COMPLETE (Item 144).

16-01. Work included. - The contractor shall design, furnish and install four traveling cranes, complete with rails and girders. One crane shall be installed in each of the four pumping stations, mounted on the track in the pumping station ready for operation, in accordance with the drawings and the specifications.

16-02. General description. - Each crane shall be hand operated, and shall have a working capacity of not less than 4 tons carried on one trolley. The distance from center line to center line of crane rails shall be 18 feet 5 inches in Station No. 1, and 16 feet 9 inches in Stations Nos. 2, 3, and 4. The distance from operating floor to top of crane rail shall be 13 feet 6 inches. Clearance limitations are shown on the drawings.

16-03. Detailed description. - a. Hoist and trolley. - The hoist and trolley shall be similar or equal to the combined geared "Army" type as manufactured by the Yale and Towne Manufacturing Company, Philadelphia, Pennsylvania, or David Brown and Son, Cleveland, Ohio. The hoist shall be equipped with hoisting chain and shall provide for a vertical lift of 35 feet. The gearing for the hoist shall be accurately machine cut and shall be of ample strength and fully inclosed with safety guards. The hoist shall be self-locking, and integral with the trolley. The hoist and trolley traverse shall be operated by chains from the operating floor. Trolley wheel bearings shall be antifriction bearings of ample capacity.

b. Bridge and end trucks. - The bridge shall consist of one I-beam girder of ample section to provide rigidity against excessive vertical deflection and side sway. The girder shall be securely attached and braced to the end trucks. The end trucks shall be of rigid construction and shall be provided with double-flanged wheels. One wheel of each end truck shall be geared to a cross shaft operated by a pendant hand chain and suitable gearing. The hand chain shall provide for one-man operation of the bridge traverse from the operating floor, and shall be located near the end of the main girder adjacent to the rear wall of the pumping station. The end truck wheels shall be equipped with roller bearings. The cross shaft bearings shall be either smoothly finished grey iron or bronze bushings.

c. Track and fastenings shall be provided and installed as shown on the drawings. Standard A.S.C.E. 30-pound rails shall be used and shall be held in place by 3/4-inch hook bolts, staggered and spaced on 18-inch centers. Suitable stops shall be provided at the ends of the tracks.

16-04. Design. - a. The detailed design of the traveling crane shall be in accordance with the clearances indicated on the drawings and with these specifications. All working parts shall be readily accessible for inspection and repair, properly designed and suitable

for the use and service required.

b. The design stress for any member or part of the material covered by these specifications shall not be greater than one-fifth of the ultimate strength of the material used.

16-05. Drawings. - The contractor shall submit for approval detail drawings for the traveling cranes he proposes to install in sufficient detail to enable a check on the design. These drawings shall include a complete and itemized list of all parts, with the grade and class of material or make of a standard article, the contractor proposes to furnish. The item number in the list of parts shall be shown on the drawing by means of a circle enclosing the item number and a solid light line connecting the circle to the part. Thickness of plates and sizes of structural shapes must be shown either on the part or in the itemized list of parts. Proposed construction shall be clearly shown on the drawings by the liberal use of sections, enlarged details and by other means. Any item or part omitted from the drawings or list of parts but needed to comply with the requirements of these specifications or any item or part omitted from the drawings or the list of parts and also omitted from the requirements of these specifications, but needed in order to provide a complete and workable installation in accordance with the intent of these specifications, shall be supplied by the contractor the same as if included on the drawings, the list of parts, or in the requirements of these specifications. Approved drawings submitted by the contractor shall become a part of these specifications.

16-06. Materials and workmanship. - Each traveling crane shall be constructed of the grade and class of materials as shown on the "List of Parts" on the design drawings as furnished by the contractor and approved by the contracting officer and shall conform to the provisions of Section XVII, where applicable. All metal workmanship shall be of approved standard quality.

16-07. Installation. - Each traveling crane, including rails and fastenings, as equipped, shall be assembled and installed in the pumping station housing it, as shown on the drawings.

16-08. Inspection and tests. The traveling crane will be tested by the Government as soon as practicable after installation. The field tests will include complete operation of the crane throughout all its functions. Acceptance and final payments will not be made until such tests are completed to the satisfaction of the contracting officer.

16-09. Painting. - Shop painting shall be in accordance with the provisions in Paragraph 14-02m and 15-12c applying to gate hoists. Such retouching as may appear necessary in the opinion of the contracting officer, shall be done with the same shade of paint as the shop coat. All finished surfaces to be exposed to the atmosphere during shipment shall be coated with a heavy rust preventive compound. Field painting of all exterior parts, except brass, bronze or finished surfaces shall

be done in accordance with the provisions in Paragraph 15-12c applying to gate hoists.

16-10. Payment. - Payment for designing, furnishing, and installing the travelling crane will be made at the contract unit price for Item 44, and includes all necessary accessories not included in any other item.

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SECTION XVII. METALS AND EMBEDDED ITEMS (Items 45 to 47 incl.)

17-01. General. All metals, unless otherwise specified, shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications. All castings shall have the pattern or mark number cast on them. Unless otherwise authorized by the contracting officer, the scale weights of each casting or forging after machining shall be within 5 per cent of the weights as calculated from the dimensions specified or shown on the drawings. Castings shall conform, at the minimum section thereof, to the following dimensional tolerances; where embedded in concrete, to within 1/8 inch; where not embedded in concrete, to within 1/16 inch of the dimensions shown on the drawings.

17-02. Materials and workmanship. - a. The articles included in Items 45 to 47 inclusive, other miscellaneous materials, and all metals required in the work except as otherwise specified, shall meet the requirements of the following specifications where applicable to the use intended:

(1) Structural steel:- Federal Specification QQ-S-711a; shapes, plates, bars, pins, and bolts shall be Class "A", and rivets shall be Class "C", unless otherwise required. Welding will be accepted only where specified or authorized, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

(2) Cold-rolled steel:- A.S.T.M. Specifications A-108-36 for "Commercial Cold-finished Bar Steels and Cold-finished Shafting". Unless otherwise specified this material shall be used for rods, pins, keys, and similar parts.

(3) Hot-rolled steel, for shafting, sleeves and rollers:- A.S.T.M. Specifications A-107-36 for "Commercial Quality Hot-rolled Bar Steels".

(4) Machine steel, same as for Hot-rolled steel.

(5) Steel, corrosion resisting, refer to U. S. Navy Specification 46-S-18c.

(6) Steel forgings, shall be of hot-rolled open-hearth steel forging bars conforming to A.S.T.M. Specifications A-18-30 for carbon steel and alloy steel forgings, Class "C", except that shafts of this material not otherwise specified shall be S.A.E. No. 1045 hot-rolled, open-hearth steel forging bars.

(7) Steel castings:- Federal Specification QQ-S-681a.

(8) Iron castings, gray:- Federal Specification

QQ-I-651, class as indicated. Tensile tests and chemical analysis will not be required.

(9) Iron castings, semi-steel:- Federal Specification QQ-I-656 for "Iron Castings, High Test (semi-steel)", class as indicated. Tensile tests will not be required.

(10) Malleable iron castings:- Federal Specification QQ-I-666, Type "A".

(11) Steel rail track and fittings, shall be standard A.S.C.E. sections and shall conform to the A.R.E.A. standard specification for carbon steel rails.

(12) Chains and attachments:- Federal Specification RR-C-271 of Type "A" and Grade "2" unless otherwise specified.

(13) Bolts, screws, and washers:- Appropriate Federal Specification and current standard practice, unless otherwise specified.

(14) Wrought-iron bars and shapes:- Federal Specification QQ-I-686, Grade "B".

(15) Cast-iron pipe:- A.S.T.M. Specifications A-44-04, Class A; for soil pipe refer to Federal Specification WW-P-401.

(16) Wrought-iron pipe:- Federal Specification WW-P-441.

(17) Black steel pipe:- Federal Specification WW-P-403, Type A, and WW-P-521.

(18) Classes C and D bronze for slide gate seats shall have the following chemical properties:

	<u>Class C</u>	<u>Class D</u>
Copper (per cent)	82.00 to 83.00	82.00 to 83.00
Tin " "	6.75 to 7.50	4.75 to 5.50
Lead " "	4.50 to 5.00	7.75 to 8.25
Zinc " "	5.00 to 6.00	4.00 to 5.00

(19) Sheet copper:- Federal Specification QQ-C-501, Type V, Class A.

(20) Zinc coatings (hot galvanized):- Federal Specification QQ-I-696.

(21) Babbitt metal:- Federal Specification QQ-M-161.

(22) Lead:- Federal Specification QQ-L-171, Grade A.

(23) Solder:- Appropriate Federal Specification
QQ-S-571 and QQ-S-551.

(24) Valves:- Federal Specification WW-V-76a.

(25) Other items, unless otherwise specified, shall conform to current standard practice for the material required and use intended.

17-03. Galvanizing and painting. - a. Galvanized iron or steel articles, as indicated on the drawings, shall be galvanized by the hot-dip process unless otherwise permitted. Injuries to the galvanizing shall be satisfactorily repaired. Provision shall be made for the protecting threads either by counter-boring fittings, so as to cover threads or by cutting threads so as to make a very loose fit before galvanizing and carefully rerunning threads after galvanizing so as to leave a good coating all over threads. Hot galvanizing shall be of such quality as to endure at least 4 one-minute immersions in copper sulphate solution, in accordance with the requirements of the Proceco test.

b. Except as otherwise specified all metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with one coat of red lead paint and two coats of an approved lead-and-oil paint to the satisfaction of the contracting officer. No painting shall be done until the condition of the surface to be painted has been approved. The paint shall be applied by either brush or spray in a neat, thorough, and workmanlike manner, and in no event shall any paint be applied in freezing, rainy, or misty weather. The paint used shall conform to the requirements of Federal Specifications of Group "TT"; and samples of paint shall be submitted to the contracting officer for approval and selection.

17-04. Miscellaneous iron and steel (Item 45). - a. Manhole and other frames and gratings, ladders, manhole steps, wire mesh fence for sub-stations and other miscellaneous iron and steel items as shown on the drawings shall be furnished and installed.

b. Payment will be made as specified in Paragraph 17-07.

17-05. Miscellaneous pipe and fittings. - (Item 46). - a. Black steel or standard wrought iron pipe complete with malleable iron fittings and connections shall be furnished and installed on the structures where shown on the plans. Pipe shall be of the size as shown on the plans and shall conform to Federal Specification WW-P-403. Pipe fittings and connections shall be malleable ball pattern and pin connected where required; post connections at the floor, and caps used on the bottoms of sleeves embedded in the concrete shall be standard screw type. All fittings shall be of Crane Company type or equal. Floor or wall flanges of screw type shall be anchored into the concrete with stud type expansion bolts consisting of one primary and one secondary expansive unit similar and equal to that manufactured by Akerman Johnson Company.

b. Payment will be made as specified in Paragraph 17-07.

17-06. Copper water stops (Item 47). - Copper water stops required for the construction joints and expansion joints of concrete work shall be furnished and installed. Copper water stops used in concrete expansion and construction joints shall be continuous, and shall be crimped for expansion joints only. Splicing of the water stops shall be done by overlapping and riveting, soldering, or brazing. Unless otherwise specified on the drawings the material shall be 20-ounce sheet copper of approved standard. At expansion joints the crimp shall be filled with a mastic filler of "elastite" or equal as manufactured by Philip Carey Company, Cincinnati, Ohio. Copper water stops shall be placed in the expansion joints indicated on the drawings, and in all construction (field) joints as directed by the contracting officer.

17-07. Measurement and payment. - a. The quantities to be paid for under Items 45 and 47, inclusive, will be the number of pounds respectively furnished and installed in accordance with the drawings and specifications. Wherever practicable, the quantities shall be determined by weighing the articles and materials. When weighing is not practicable, the actual weight of each part or item involved will be determined by the contracting officer, who will use for that purpose manufacturers' weights, catalog weights, and computed weights. The weight of all tare, packing, and blocking will be deducted, using only net weights for payment quantities; provided, that no payment will be made for any weight in excess of 5 per cent more than the computed weight as determined from the drawings.

b. In calculating computed weights the following unit weights of the several materials will be used unless otherwise specified:

Structural Steel - 0.2833 pounds per cubic inch.

Cast Iron - 0.2604 " " " "

Brass and Bronze - 0.310 " " " "

Wrought Iron Pipe - The weight per linear foot shown in Table I of Federal Specification WW-P-441.

Black Steel Pipe. - The weight per linear foot shown in Table I of Federal Specification WW-P-403.

Copper Water Stops. - 20-ounces per square foot.

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SECTION XVIII. ELECTRIC WIRING AND CONDUITS (Items 48 to 51 incl.)

18-01. Definitions. - Item 48, "Lighting System", shall include the wiring and fixtures required for the electric lighting of four pumping stations, and the conduit required for the lighting and power circuits, as shown on the drawings. Other electrical equipment shall include Item 49, "Fiber Conduit", Item 50, "Lead-Covered Cable", and Item 51, "Pull Boxes".

18-02. Lighting system (Item 48). - a. Work included. - The contractor shall furnish and install complete and ready for operation all equipment and wiring for the lighting of the pumping stations and conduit for the lighting and power circuits inside the pumping stations as shown on the drawings or as required by these specifications.

b. Standard rules and specifications. - The contractor shall install all of the electrical work in a workmanlike manner and the installation shall be in accord with the current standard rules, regulations and specifications of the following authorities:

(1) American Institute of Electrical Engineers, 33 West 39th Street, New York, N. Y.

(2) National Board of Fire Underwriters. National Electrical Code (85 John Street, New York, N. Y.)

(3) National Electrical Manufacturers Association (155 East 44th Street, New York, N. Y.)

(4) Federal specifications cited herein (Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.)

c. Conduits. - (1) Conduits shall be hot-dip galvanized or sherardized on both inside and outside, and shall meet the requirements of Federal Specification WW-C-581a for "Conduit, Steel, Rigid, Zinc-coated".

(2) Conduit sizes shall meet the requirements of Article 346 of the 1937 edition of the National Electrical Code with the exception that no conduits smaller than 3/4" shall be used.

(3) Conduits run in the floor shall be in the structural portion of the floor.

(4) Conduits shall be plugged and kept clean and dry during installation. Conduits run exposed shall be rigidly held in place by straps and joints and shall be made watertight with an approved sealing compound.

d. Wiring. All wiring shall be in rigid conduit unless otherwise specified as shown on the drawings or directed by the contracting officer. All wire used shall be copper, soft drawn and annealed, with not less than 95 per cent conductivity. Wire sizes shall comply with Article 300 of the National Electrical Code. No wire shall be used that is smaller than No. 12 A.W.G. except fixture wiring which shall not be less than No. 18 A.W.G.

(2) Insulation for all wires shall be flame retarding and moisture proof and shall conform to Federal Specifications J-C-106 for "Cable and Wire; Rubber Insulated Building Type, Superaging Grade (0 to 5,000 volt service)".

(3) Silver Solder shall conform to Federal Specification QQ-S-561b "Solder Silver".

(4) Rubber tape shall conform to Federal Specification HH-T-111 for "Tape, Rubber Insulating".

(5) Friction tape shall conform to Federal Specification HH-T-101 for "Tape Friction" Grade A.

(6) Cotton tape shall conform to United States Navy Department Specification 17-T-15 for "Tape Insulating, Linen Finish, thickness .007 inch".

e. Grounding. - (1) Permanent and effective ground connections shall be provided for all metal cabinets enclosing electrical equipment, for equipment frames and housings, continuous runs of metal conduit, and elsewhere to comply with Article 250 of the National Electrical Code, and as specified or directed by the contracting officer. The contact area of all joints in grounding circuits shall provide a current-carrying capacity not less than that of the connecting wire or cable, and the joints shall be bolted, soldered or brazed, as specified or as directed. All ground connections to equipment that may require removal for maintenance or repair shall be bolted to the equipment.

(2) The lead sheaths of all lead-covered cable shall be grounded through copper conductors attached by means of suitable copper straps fastened to the cables at each pumping station. All pull boxes shall be grounded through the lead sheaths of the cables by means of copper conductors attached to the cables by means of suitable straps.

(3) Solder for brazing shall conform to Federal Specification QQ-S-551, for "Solder, Brazing Composition B".

f. Lighting and outlets. - (1) All lighting fixtures shall be installed as specified and at the locations indicated on the drawings and shall be similar and equal to Benjamin "RLM" Reflector Catalog No. 9642.

(2) The floodlights shall be located outside the structures as shown and shall be made adjustable so that the area around the gates at each pump station and the dike wall can be lighted. They shall be similar and equal to Crouse-Hinds Catalog No. 42746. The bulbs for floodlights shall be 1500 watts, 110 volts, Type G lamps, beam spread; 35° Horizontal, 14° Vertical. Each floodlight shall be furnished with a pedestal base of sufficient height to bring the center of the projector approximately three (3) feet from the base.

(3) Receptacles for convenience outlets shall be 15 ampere size, duplex type, composition case top-wired with insulated mounting yoke similar and equal to Benjamin Catalog No. 4832.

(4) The lighting panelboard in each pumping station shall be of the air circuit breaker type for surface mounting and shall conform to Federal Specification W-P-131.

(5) Conduit bodies shall be galvanized, sherardized, or cadmium-plated high test alloy castings of the types and sizes required for the work to be done. They shall be approved by the National Board of Fire Underwriters and be similar and equal to those manufactured by the Crouse-Hinds Company.

g. Installation. - The installation shall be in accordance with approved detailed drawings, of the materials as specified and required for the respective parts of the work, and shall be done in a workmanlike manner.

h. Tests. - (1) Final tests shall be made of all electrical equipment and wiring, as directed by the contracting officer, to determine that all equipment is in good working order and in compliance with these specifications.

(2) The costs of all tests shall be borne by the contractor, except for the Government's representatives, and shall be included in the contract price for the item.

i. Payment. - Payment for furnishing and installing the lighting system complete for four pumping stations will be the lump sum contract price for Item 48 "Electric Lighting System". Payment will be made in one sum after the equipment has been furnished, installed, connected and tested to the satisfaction of the contracting officer.

18-03. Fibre conduit (Item 49). - a. Work included. - The contractor shall furnish and install fibre conduit in the concrete dike wall and at other locations as shown on the drawings and as required by these specifications.

b. Description. - All fibre conduit shall be made of finely divided wood pulp or fibre thoroughly impregnated with bituminous insulating compound to give the walls a hard, compact, homogeneous surface

with a nominal thickness of $1/4$ inch. The conduit shall not be affected by acids, alkalies, or moisture and shall be free from all substances which might corrode or injure the lead sheath or rubber compound of a cable. All fibre conduit shall be of approved standard construction and shall be similar and equal to the orangeburg fibre conduit manufactured by the Fibre Conduit Company, Orangeburg, New York. The material shall be such that it will not absorb more than 3 per cent by weight of water when submerged for a period of 96 hours nor shall it begin to soften at a temperature less than 55 deg. C. All fibre conduit shall be $3-1/2$ inches inside diameter.

c. Installation. - (1) Conduit locations in the dike wall and at the stop-log structures shall be as shown on the dike wall drawings. All bends shall be wide radius bends not less than 10 times the nominal conduit diameter.

(2) Sleeve type joints shall be used throughout. Fibre conduit shall be the tapered-end type construction. A sleeve of the same material as specified for the conduit shall be furnished for each length of conduit, machine-cut to an internal taper at each end, the taper being the same as for the conduit. The minimum thickness of the sleeve shall be not less than one-half of the nominal thickness of the conduit. The tapers on the conduit and sleeve shall be so cut that when the joint is made up the ends of the conduit will not touch or be separated by more than $1/2$ inch.

(3) Conduits shall be supported during concrete pouring at regular intervals to prevent misalignment. Fibre conduits terminating in formed concrete outlets at the pump stations shall be fitted with end-bells. The concrete wall between conduits shall be not less than 4 inches at any point. Where conduits pass through an expansion joint in the masonry approved expansion joints of the sleeve type shall be used. All joints shall be made watertight with an approved sealing compound.

(4) During concrete-pouring operations, care shall be exercised to avoid damaging the conduit installation. The concrete shall be of a suitable mix and shall be carefully worked in between and around the individual conduits so that each conduit will be completely enveloped in concrete without voids.

(5) At pull boxes the conduit shall be tapered and fitted tightly into the conduit opening in the pull box extending at least $1/4$ inch inside the box.

d. Inspection and test. - Each piece of fibre conduit shall be capable of passing a mandrel 36 inches long and having a diameter $1/8$ inch less than the inside diameter of the conduit. A 5-foot straight edge laid lengthwise on the concave side of a 5-foot length of conduit shall not show an offset of more than $1/4$ inch. The fibre conduit shall be capable of withstanding a puncture test of 140 volts per mil dielectric.

e. Measurement and payment. - The quantity to be paid for under Item 49 shall be the number of linear foot of fibre conduit satisfactorily installed in accordance with the specifications and drawings. The measure of quantity shall be made after installation. Payment will be made at the unit contract price for Item 49.

18-04. Lead covered cable (Item 50). - a. Work included. - The contractor shall furnish and install lead covered cable for the power distribution system and for all electric motor feeders as shown on the drawings and as required by those specifications.

b. Standard rules and specifications. - The contractor shall install all of the lead covered cable in a workmanlike manner and the manufacture and installation shall be in accordance with the current standards, rules, regulations and specifications of the Insulated Power Cable Engineers Association, 420 Lexington Avenue, New York City, New York, and other authorities as referred to in Paragraph 18-02b.

c. Specimen. - The contractor shall furnish the contracting officer specimens of the lead covered cable, splicing material and other items entering into the formation of joints, and shall furnish complete data pertaining to the lead cable that he proposed to furnish.

d. Cable. - All power cable shall be three-conductor rubber-insulated lead-covered, suitable for an operating voltage of 2300 volts, 3 phase, 60 cycle, A. C. and shall conform to Federal Specifications J-C-121 for "Cable and Wire; Rubber Insulated, (For) Other than Building Purposes, Superaging-Grade (0 to 8,000 volt Service)". The conductors shall be copper with standard stranding having tape or braid over the rubber insulation on each conductor, and in addition, they shall have an overall tape enclosing the three insulated conductors. A sheath of alloy lead, containing between 1.8 and 2.2 per cent tin shall be tightly formed around the core.

e. Pulling in lead covered cables shall be in accordance with the best standard practice and as follows:

(1) A mandrel shall be pulled through all conduits into which the cables are to be drawn, to remove obstructions. The open ends of all cables shall be sealed with wiping solder before pulling into the conduit and as the cable is pulled into the conduit an approved lubricant shall be applied to the surface of the lead sheath. A mesh wire pulling grip shall be used.

(2) The mandrel shall be of an approved construction that will pass the bends in the conduit runs and shall be submitted for the approval of the contracting officer.

(3) All mechanical work, including the installation of cable supports, brackets, shelves, hangers and pull boxes, shall be completed as nearly as possible before the installation of any cable.

f. Splices in lead covered power cables. - (1) The cables shall be pulled-in in sections. The distance between any two pull boxes being one section, and the sections shall be spliced in the pull boxes making continuous circuits in accord with the circuit diagram. At the pull boxes the cable splices shall be supported on the hangers provided in the pull boxes.

(2) Splices in the cable shall be made by experienced cable splicers in accordance with the latest approved methods of the Insulated Power Cable Engineers Association and to conform to the requirements of the manufacturer of the cable.

g. Materials for splicing. - (1) Stearine shall conform to U. S. Army Standard Specification No. 71-44SA for "Stearine, Compound, Type IC-3".

(2) Twine shall be six-ply waxed linen twine subject to the approval of the contracting officer.

(3) Rubber insulating tape shall conform to Federal Specifications HH-T-111 for "Tape; Rubber Insulating".

(4) Varnished cambric tape shall conform to United States Navy Specifications 17-C-8 for "Cambric, Insulating, Varnished" thickness 0.010 inches.

(5) Rubber cement shall conform to the U. S. Navy Department Standard Specifications 52 C-3a for "Cement, Rubber".

(6) Insulating compound for filling lead cable splices shall be similar and equal to "Ozite A" as manufactured by the General Cable Corporation.

(7) Solder for splicing or wiping shall conform to Federal Specification QQ-S-571 for "Solder Tin Lead", Grade A.

h. Installation. - The installation shall be made in accordance with the approved detailed drawings and as required by these specifications and as approved by the contracting officer.

i. Cable and conductor labeling. - After installation, all cables shall be numbered in accordance with a numbering system which will be prescribed by the contracting officer, and which will be shown on the wiring diagrams. The cable number shall be stamped at each cable terminal and on each entrance opening on the pull box. Each cable shall also be labeled by means of tags fastened to the cable at each pull box and pumping station. These tags shall be the Electric Service Supplies Company's No. 12413 or equal.

j. Tests. - (1) After the cables are pulled in but before they are connected to the equipment, the complete cable system shall be tested for insulation resistance in accordance with the standards of the American Institute of Electrical Engineers. The insulation resistance per unit length for any section of cable, including splices, shall be not less than that prescribed in the applicable specifications for the cable tested (see Paragraphs 18-04d and e). All tests shall be made in the presence of the contracting officer or his authorized representative.

(2) The costs of the test shall be borne by the contractor, except for the Government's representatives and shall be included in the contract price for the item.

k. Measurement and payment. - The quantity to be paid for under Item 50 shall be the unit price per lineal foot of spliced lead covered cable satisfactorily placed in accordance with the specifications and drawings. The measurement of quantity shall be made after splicing the lead covered cable and satisfactory installation and tests.

18-05. Pull boxes (Item 51). - a. Work included. - The contractor shall furnish and install cast iron pull boxes complete with covers, splice hangers and accessories necessary to make a complete installation in their respective locations as shown on the drawings.

b. Description. - The pull boxes shall be of cast iron and shall be of the recessed flange type for flush mounting and shall be provided with galvanized cast iron covers, mounted by means of bronze lock type screws and shall be fitted with hangers for supporting the cable splices. The dimensions shall be as shown on Sheet No. 80 of the drawings. The pull boxes shall be similar and equal to the standard product of The Thomas & Betts Company, Inc., Elizabeth, N. J.

c. Painting. - The inside of the box shall be thoroughly cleaned, by scrapers, wire brushes, sand blast or other effective means to remove all scale, rust, dirt, and oil from the surface to be painted. When the surfaces are perfectly clean, warm and dry, they shall be given one coat of red lead paint and two coats of weather proof paint.

d. Measurement and payment. - Payment will be made under Item 51 as specified in Paragraph 17-07.

SECTION XIX. INSTALLATION OF EQUIPMENT (Item 52)

19-01. Installation of pumping station and substation equipment.

a. Classification. - The following equipment will be furnished by the Government:

- (1) Pumps complete with motors, piping and valves.
- (2) Switchboard complete.
- (3) Electrical substation equipment.

b. Work included. - The contractor, under the supervision of a representative of the manufacturer furnished by the Government shall install the equipment according to the drawings and the requirements of these specifications or by methods approved by the contracting officer.

19-02. Workmanship of installation. - The contractor shall install, erect, attach or build into the structures all the machinery, piping, and other metal work in a workmanlike manner as specified or directed by the contracting officer. All work of the installation of the equipment shall follow the best modern practice in the installation of machinery of this type, notwithstanding any omission from these specifications, and shall be performed under the supervision of a representative of the manufacturer. All work shall be done by mechanics skilled in their various trades, and wherever possible all parts shall be made accurately to standard gauge to facilitate replacement and repair.

19-03. Delivery. - The equipment listed in Paragraph 19-01 will not be available prior to 150 days after notice to proceed. Any or all of the equipment will be available thereafter and the contractor shall notify the contracting officer of the desired date of delivery (see Paragraph 1-14).

19-04. Pumps, motors, discharge piping, gate valves, strainers and accessories. - a. Four 24-inch and four 30-inch propeller type pumps complete with motors, discharge piping, gate valves, strainers, anchor bolts and accessories shall be installed in the pumping stations at the locations as shown on the drawings. Every detail of the work shall be done in a thoroughly workmanlike manner. The complete pumping unit shall be set accurately plumb and anchored to the concrete floor slab by means of anchor bolts. The wall section of each pump shall be grouted in after the pump is assembled. The anchor bolts shall be set at the time the concrete is poured by means of templates furnished by the pump manufacturer. The gate valves and horizontal discharge piping will be supported by suspension hangers as shown on the drawings. All discharge piping shall be securely anchored to the sump floor and at the section extending through the pumping station wall.

b. Installation test. - Special care shall be exercised when aligning motor and pump shafts to insure free running in the bearings without binding. The shafts shall be turned by hand for at least 50 complete revolutions of the pump impeller. After the pump unit is completely

installed it shall be given a thorough check for alignment and anchorage. The gate valves shall be opened and closed to insure free travel from the fully closed to the fully open positions. The flap valve shall be swung open and shut without causing any undue binding.

19-05. Switchboards. - a. Work included. - Four switchboards to be installed will be furnished by the Government. They shall be installed in the pumping stations at the locations as shown on the drawings or as required by these specifications or as approved by the contracting officer. The installation shall be in conformity with the current rules and regulations of the National Electrical Code.

b. The contractor shall make all connections to the main feeders through the potheads furnished with the switchboards. He shall run all wires for lighting and cable for motors through rigid conduit forming a complete raceway from the switchboard to the last outlet in the system or as otherwise specified on the drawings or required by the contracting officer. He shall connect the pump motors, lighting and lighting panel and all necessary connections to complete the electrical installation of the switchboard. Conduits in masonry walls shall be built-in complete with all necessary fittings at the time masonry work is being done. All feeder cables shall be racked on suitable hangers and run parallel with the structural portions of the building. The contractor shall furnish the necessary conduit and wiring (Items 48 and 49) and lead covered cable (Item 50) to complete the installation. The switchboard shall be securely anchored to the structural concrete floor slab with suitable anchor bolts and shall be grounded as required in Paragraph 18-02 e.

19-06. Substation equipment. - a. Work included. - (1) Two 750 KVA substations consisting of transformers, steel structures, switchgear, lightning arresters, potheads, conductors, insulators and all other equipment necessary to complete the substations will be furnished by the Government to be installed by this contractor. The transformer installation at each substation will consist of a bank of three single-phase transformers delta-connected on both primaries and secondaries. The transformers will set on concrete foundations furnished by this contractor as provided for in Paragraph 12-02 of this specification. The steel structures shall be assembled, mounted and fastened to concrete footings, and the switchgear and protective equipment with busses and insulators shall be mounted and connected in accordance with drawings to be furnished by the contracting officer.

(2) The incoming overhead tie-lines for supplying power will be connected by others to insulators on the substation structure. The primaries of the transformers will be connected to the tie-lines by means of air-break switches of the horn-gap type. The primary bus and transformer windings will be protected by means of fuses, and the substation will be protected against lightning surges by means of lightning arresters connected as shown in the circuit diagram.

(3) The transformer secondaries at each substation will

be brought into a manually-operated double-throw oil switch which will transfer the secondary to either one of the two main feeders, from the pumping station, run to the oil switch and connected through potheads.

b. Transformers. - (1) The contractor shall install six 250 KVA transformers as furnished by the Government in sets of three for each substation. He shall connect the transformers and make all connections to complete electrical hook-up to the switchboard and incoming power lines.

(2) Payment for the concrete foundation will be paid for under Item 37, "Class "A" Concrete" (Paragraph 12-02).

c. Steel structure. - The steel structure as furnished by the Government shall be erected according to the factory drawings and as directed by the contracting officer. The structure shall be securely anchored to the concrete foundation as required in Paragraph 11-18.

19-07. Substation inclosure. - a. The contractor shall furnish and install a fence around each station. The fence shall be 7 feet high and shall extend completely around the substations, and shall comply with Federal Specification RR-F-191, "Fencing, Chain-Link or Welded, Type B." That portion of the fence paralleling the wall shall be erected on top of the wall. The fence shall be constructed of 2-inch mesh heavy galvanized steel. A suitable gate with a latch and lock shall be provided for entrance to the substation inclosure.

b. Payment. - Payment for furnishing and erecting fence shall be included in the contract unit price for Item 45, "Miscellaneous Iron and Steel."

19-08. Tests. - After complete installation of pumping station and substation equipment the contractor shall make a running test of sufficient duration to ascertain that all equipment is in good running condition. Any changes or adjustments necessary to secure satisfactory operation shall be made by and at the expense of the contractor. Provided that if any part of the equipment is found to be defective due to no fault of the contractor as determined by the contracting officer, the contracting officer may order the contractor to correct such defects and payments therefor will be made to the contractor under the provisions of Article 3 of the contract.

19-09. Payment. - Payment for installing pumps, motors, switchboards and substations and accessories will be made at the contract price under Item 52 and shall include the cost of unloading and hauling from the point of delivery, storing, handling, assembling, erecting, cleaning, placing, painting, testing, and maintaining the same until final acceptance thereof by the contracting officer, and also the construction of the fence around the substations. Payment will be made at the lump sum price for Item 52, "Installing Equipment Furnished by the Government."

SECTION XX. MISCELLANEOUS (Items 53 to 60 Incl.)

20-01. Installing miscellaneous pipe and fittings. (Item 53). - a. Work included. - The contractor shall install miscellaneous vitrified clay pipe, black steel and cast iron pipe and fittings to extend existing facilities through the concrete flood wall and at other locations as shown on the drawings or directed by the contracting officer. All connections shall be made tight with screwed, flanged, cemented, or caulked and leaded joints as indicated or directed. The pipe and fittings shall be purchased by the contractor in the amounts, type and class of material approved by the contracting officer.

b. Payment. - (1) Payment shall include all costs of installing and connecting the pipe, including local transportation costs not provided for in Subparagraph (2) below. Payment will be made at the contract unit price for Item 53, "Installing Miscellaneous Pipe and Fittings."

(2) Additional payment for furnishing miscellaneous pipe and connections will be made on the basis of certified receipted bills for materials delivered in Holyoke. The amount of the additional payment will be the net amount of the bills submitted as above, and approved by the contracting officer. Payment shall include all costs of furnishing pipe and fittings at the site of the work.

(3) Payment for excavation and backfill will be made at the contract unit prices for Items 4, 7, and 15, as applicable.

20-02. Installing miscellaneous gate valves (Item 54). - a. Work included. - The contractor shall install miscellaneous gate valves for use in connection with the pipe installed under Item 53, as indicated on the drawings or directed by the contracting officer. Connections shall be made tight with screwed or flanged joints as indicated or directed. The valves, stands and accessories shall be purchased by the contractor in the number, type and class as approved by the contracting officer.

b. Payment. - (1) Payment under Item 54 shall include all costs of installing and connecting the valves, stands and accessories including local transportation costs not provided for in Subparagraph (2) below. Payment will be made at the contract price per valve for Item 54, "Installing Miscellaneous Gate Valves."

(2) Additional payment for furnishing valves, stands and accessories will be made on the basis of certified receipted bills for the equipment delivered in Holyoke. The amount of the additional payment will be the net amount of the bills submitted as above, and approved by the contracting officer. Payment shall include all costs of furnishing valves, stands and accessories at the site of the work.

20-03. Timber stoplogs (Item 55). - a. Work included. - Creosoted timber stoplogs shall be furnished and installed for the stop-log structures

at the locations shown on the drawings or as directed by the contracting officer.

b. Materials. - (1) Creosoted timber shall be No. 1 Common plain white oak conforming with the Standard Grading and Dressing Rules of The National Hardwood Lumber Association and to Federal Specification MM-L-736, "Lumber and Timber; Hardwood." Timber shall be treated with a creosote-coal-tar-solution conforming to Federal Specification TT-W-566, "Wood-Preservating; Creosote-Coal-Tar-Solution (for) Ties and Structural-Timbers." (See Specification No. 5-b of the American Wood Preservers' Association). Timber shall be treated by the pressure process in accordance with Federal Specification TT-W-571a, "Wood-Preservative; Preservative-Treatment." The minimum absorption of preservative shall be 6 pounds per cubic foot by the empty cell treatment (see specification for treatment, American Wood Preservers' Association Specification No. 34-b).

(2) For bolts and other necessary hardware, see Section XVII.

c. Description. - Stoplogs shall be carefully framed to fit the stop-log structures, and shall be installed as shown on the drawings or stored as directed by the contracting officer.

d. Measurement and payment. - Measurement for payment will be based on the number of thousand feet board measure furnished and stored, and will be in accordance with the standard grading rules of the National Hardwood Lumber Association. Payment will be made at the unit contract price for Item 55 and shall include all costs of furnishing, treating, and installing timber stoplogs. All bolts, nuts, washers or other hardware necessary for proper construction and installation, will be paid for as specified in Section XVII.

20-04. Placing topsoil and sodding embankment slope (Items 56 and 57), - a. Work included. - The contractor shall furnish and place topsoil on the slopes of the earth dike as shown on the drawings, and on other areas as required by the contracting officer. The words "soil" or "topsoil" shall mean the material composing the surface layers of the ground containing varying amounts of organic matter. The finished embankment dimensions shall be as shown on the drawings. Under Item 56, acceptable topsoil shall be placed to the required depth over the required areas. Under Item 57, the prepared topsoil surface shall be sodded and seeded when and as directed by the contracting officer.

b. Placing topsoil. - After the earth dike has been completed to required height and dimensions, the contractor shall apply the stored topsoil (see Paragraph 5-01 b (2)) or additional acceptable topsoil if required, to the required depth when compacted, over the slopes of the embankment to the limits shown on the drawings. The topsoil shall be lightly rolled or tamped and any unevenness of surface shall be corrected to conform to finished grades.

c. Sodding. - (1) The slopes of the earth dike shall be planted by spot sodding with living sods of Bermuda or some other acceptable grass which will best meet the climatic conditions as approved by the contracting officer. Each sod shall have an area of not less than 16 square inches. Sods shall be placed not more than 18 inches center to center for the minimum-sized sods; larger sods may be spaced proportionately, depending on their size. Sods shall be covered with one-half to one inch of earth, in such manner as to protect the roots from drying out. Sods shall be placed as soon as practicable after cutting, and newly placed sods shall be kept moistened by sprinkling when and as required by the contracting officer for the entire period of the contract.

(2) Sodding shall be commenced immediately upon completion of the dike to final grade and cross section and shall be prosecuted at a rate satisfactory to the contracting officer. Seeding shall be done to supplement the sodding operations.

d. Seeding. - (1) Preparation. - All grass or cover crop seed shall be sown at the earliest practicable date in the spring, or when directed by the contracting officer, so as to secure the greatest possible protection against erosion. The finished surface grade of the slopes shall be maintained in a true and even condition during the seed-sowing operation, and the contractor shall rake the soil to a depth of three-quarters of an inch ($3/4$ ") by using iron rakes immediately previous to sowing seed. All raking shall be done in a direction parallel to the contour lines on the slope and not uphill or downhill. All sticks, stones, weeds or trash appearing on the surface shall be removed.

(2) Seed mixture. - The following mixture will be approved for each acre of seeding:

Perennial Rye Grass	7 lbs.
Orchard Grass	15 lbs.
Hard Fescue	4 lbs.
Kentucky Blue	6 lbs.
Sheep Fescue	6 lbs.
Timothy	7 lbs.
Perennial Red Clover	4 lbs.
White Clover	4 lbs.
Red Top	7 lbs.

Total per acre 60 lbs.

For all seeded areas, about 15 pounds of oats per acre shall be added if the planting is done between the middle of June and the middle of September, and about 15 pounds of winter rye per acre shall be added if the planting is permitted and done in the late season after the middle of September.

(3) Method of seeding. - The contractor shall take advantage of favorable weather and shall employ a method of sowing satisfactory to the contracting officer. The seed shall be raked in and the

whole surface then lightly rolled. Seeding shall be done immediately after the preparation of the earth surface unless otherwise directed. If there be any delay, and if weeds grow in and with the grass, such weeds shall be cut before they go to seed or at such time as directed by the contracting officer. If any loam is washed away or any portions of the seeded areas are not covered by grass, the contractor shall replace the topsoil, fertilize and re-seed.

(4) Maintenance. - The contractor shall maintain the areas sown to grass seed on each section of the project, until all work on the entire contract has been completed and accepted by the contracting officer. This maintenance shall consist of occasional mowing with a scythe or mechanical mower, watering during periods of drought, and removal of conspicuous weeds, or any other similar operations whenever required by the contracting officer. The turf areas shall be fertilized with an acceptable commercial lawn fertilizer of a quality equal to Vigoro or Scott's lawn fertilizer at the customary quantity per acre recommended by the manufacturer.

c. Measurement and payment. - (1) The quantity of topsoil to be paid for under Item 56 will be the number of cubic yards actually placed in accordance with directions, measured after compacting, whether obtained from stockpiles or from other sources at the expense of the contractor. Payment shall include the costs of all labor, materials and expenses incidental to furnishing and placing the topsoil. Payment will be made at the contract unit price, Item 56, "Topsoil on Embankment."

(2) The quantity to be paid for under Item 57 will be the number of acres sodded and seeded as directed. The measurement will be actual superficial areas sodded and seeded. Payment shall include all costs for sodding and seeding as specified in subparagraphs c and d above, and for all materials and expenses incidental thereto. Payment will be made at the contract unit price, Item 57, "Sodding and Seeding."

20-05. Surfacing for top of dike (Item 58). - a. Work included. - The contractor shall furnish and place gravel of the sizes and quality specified or directed and clay binder for the surfacing of the top of the dike, as shown on the drawings or as directed by the contracting officer.

b. Material. - The gravel shall be composed of hard, durable stones, free from thin or elongated pieces, and mixed with sand and clay or other approved binding material. The gravel shall be of such sizes that all will pass through a screen with 3/4-inch square openings, and not less than 35 per cent will be retained on a screen with 1/4-inch square openings, and shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the contracting officer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or mixed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The surfacing shall be placed in one layer, and shall be 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the surfacing shall be spread evenly by means of approved spreader vehicles or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the material shall be graded and compacted to the required thickness by rolling with a self-propelled three-wheel roller weighing not less than ten tons, until a firm even surface is obtained. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results.

(2) Compacting of the material shall start longitudinally at the side and gradually proceed toward the center of the roadway so far as practicable, overlapping on successive trips. During the process of compacting the material shall be dragged; the dragging and compacting shall continue until the surfacing does not creep or wave under traffic.

d. Shoulders. - Shoulders shall be constructed as shown on the drawings and carefully maintained. Before the completion of the work the shoulders shall be reformed, trimmed, and dressed as required by the contracting officer.

e. Measurement and payment. - The quantity to be paid for under Item 58 will be the number of cubic yards of surfacing furnished in accordance with directions within the limits designated, measured in place after compacting. Payment will be made at the contract unit price, Item 58, "Surfacing for Top of Dike."

20-06. Surfacing for roads (Item 59). - a. Work included. - The contractor shall furnish and place gravel of the sizes and quality specified or directed with a clay binder for the surfacing and shoulders of roadways, to the lines and grades shown on the drawings.

b. Material. - The gravel shall be composed of hard, durable stones, free from thin or elongated pieces, and mixed with sand and clay or other approved binding material. The gravel shall be of such sizes for the bottom course that all will pass a 3-inch screen with square openings and not less than 40 per cent will be retained on a 1/4-inch screen with square openings; and for the top course all will pass through a 3/4-inch screen with square openings, and not less than 35 per cent will be retained on a 1/4-inch screen with square openings; and for either course it shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the contracting officer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or mixed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The 12-inch gravel surfacing shall be placed in two layers, a base course and a top course, each 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the bottom course of material shall be spread evenly by means of approved spreader vehicles or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the material shall be thoroughly compacted, by rolling with a self-propelled three-wheel roller weighing not less than ten tons, until a firm even surface is obtained. After the bottom course has been properly and satisfactorily compacted the top course shall be spread and compacted to the required thickness. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results.

(2) Rolling shall start longitudinally at the side and gradually proceed toward the center of roadway overlapping on successive trips. During the process of rolling the material shall be dragged; the dragging and rolling shall continue until the surfacing does not creep or wave under the roller.

(3) The 6-inch gravel surfacing shall be placed in one layer 6 inches thick after compaction. Material and workmanship shall conform to that specified above for the top course of the 12-inch gravel surfacing.

d. Shoulders. - Shoulders shall be composed of gravel, practically free from loam and clay and with all stones larger than four inches removed. Before the final completion of the work the shoulders shall be reformed, trimmed, raked and rolled.

e. Measurement and payment. - The quantity to be paid for under Item 59 will be the number of cubic yards furnished and placed in accordance with the drawings or as directed by the contracting officer. The gravel will be measured in place after compacting. Payment will be made at the contract unit price, Item 59, "Surfacing for Roads" and shall include payment for all expenses incidental to furnishing, placing, rolling or otherwise compacting the gravel.

20-07. Bituminous macadam road surface (Item 60). - a. Work included. The contractor shall furnish and place the bituminous macadam road surface shown on the drawings, in the locations shown on the drawings or otherwise designated by the contracting officer, after the gravel base shall have been placed in accordance with the drawings and the provisions of Paragraphs 8-01 and 20-06. The surface course shall be composed of broken stone and bituminous material applied by the penetration method, with a bituminous seal coat and covering of pea stone. Care shall be taken not to spatter bituminous material on surfaces adjacent to the work.

b. Materials. - The broken stone for the surface course shall consist of clean crushed rock, thoroughly screened, uniformly graded in size and quality, angular and free from rounded surfaces; and no flat, elongated or otherwise objectionable stone shall be used. All stone shall meet the following requirements.

<u>No. 1 Stone</u> <u>Square openings</u>	<u>Per cent</u> <u>passing</u>
2-1/4"	90-100
1-1/4"	0- 40
3/4"	0- 5
 <u>Pea stone</u> <u>Square openings</u>	 <u>Per cent</u> <u>passing</u>
1/2"	90-100
1/4"	0- 20

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar.

c. Placing. - (1) Shoulders shall be relined and graded before the surface course is spread, in order to hold the broken stone in place and to permit the roller to lap at least one-half the width of the rear wheel when rolling the edge of the top course. A course of No. 1 stone shall then be spread upon the prepared base course to the ordered depth and dry rolled. The rolling shall be done by a suitable roller. Before the No. 1 stone is spread, the pea stone shall be deposited along the shoulders in convenient piles, from which it shall be spread on the surface course as directed. No hauling will be permitted over the No. 1 stone after it has been spread.

(2) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top surface shall be at the required grade. Rolling shall continue until the course has been satisfactorily compacted to a uniform surface. Any depressions or irregularities which may occur shall be filled with broken stone as directed, and again rolled until the surface is true and unyielding. Precautions shall be taken to prevent the depositing of dirt or other materials in the voids of the broken stone.

(3) No bituminous material shall be applied on stone which has become coated or mixed with dirt or foreign substances. No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or above 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat of bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure distributor, at approved temperatures

appropriate for the grade of bituminous material used, and distributed under approved pressures of from 40 to 60 pounds per square inch.

(4) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry pea stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be broomed to break up all clumps and product a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Additional pea stone shall be applied as required and directed. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(5) As soon as practicable after the pea stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat; except, that the rate of application shall be $3/4$ gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean dry pea stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material, care being taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until an unyielding, uniform and well-bonded surface is produced. Any damage to the finished surface caused by the working equipment or otherwise, shall be satisfactorily repaired.

B. Measurement and payment. - The quantity to be paid for under Item 60 will be the number of square yards of bituminous macadam surface of the required quality and thickness satisfactorily placed in the work, measured after placing. Payment will be made at the contract unit price, Item 60, "Bituminous Macadam Road Surface." The unit contract price shall include all costs of furnishing materials, equipment, tools, labor and all work incidental to satisfactory construction.

20-08. Cleaning up. - a. Work included. - The contractor shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a clean condition satisfactory to the contracting officer. All materials salvaged shall be the property of the contractor.

b. Payment. - For all work, materials and incidentals required to clean up as set forth in a above, the contractor will receive no direct payment, but payment shall be considered as having been included in the contract prices for Items 1 to 60, inclusive.

UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND
MAY 23, 1939

STANDARD GOVERNMENT FORM OF BID

(Construction Contract)

(Place) _____

(Date) _____

To the District Engineer,
U. S. Engineer Office,
819 Industrial Trust Bldg.,
Providence, R. I.

In compliance with your invitation for bids dated _____,
and subject to all the conditions thereof, the undersigned

a corporation organized and existing under the laws of the State of

a partnership consisting of _____

or an individual trading as _____

of the city of _____

heroby proposes to furnish all plant, labor, and materials, except the
equipment and materials specified in Paragraph 1-14 and Section XIX of
the specifications, and perform all work required for the construction
of a Concrete Flood Wall, Earth Dike and Appurtenant Structures on the
Connecticut River at Holyoke, Massachusetts, including all work in-
dicated on the drawings, or required by the specifications, and such

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incidental work as needed or ordered in writing by the contracting officer, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

Item No.	Designation	Unit	Quantity	Unit Price	Amount
1	Preparation of Site	Acre	5.0		
2	Control and Diversion of Water and Sewage	job.	--		
3	Support of Railroad Tracks	"	--		
4	Common Excavation, General	cu.yd.	59,000		
5	Impervious Borrow Excavation	" "	2,200		
6	Random Borrow Excavation	" "	1,200		
7	Trench Excavation	" "	3,200		
8	Rock Excavation	" "	250		
9	Shooting - Timber	M.F.B.M.	100		
10	Shooting - Steel	sq.ft.	16,000		
11	Steel Sheet Piling	" "	136,000		
12	Impervious Fill, Placing and Rolling	cu.yd.	2,200		
13	Random Pervious Fill, Placing and Rolling	" "	2,400		
14	Gravel Bedding	" "	2,600		
15	Random Backfill	" "	39,000		
16	Rock Fill	" "	500		
17	Riprap, Hand-Placed	" "	550		
18	Riprap, Grouted	cu.yd.	40		
19	Rubble Masonry	" "	400		
20	Rock for drains	" "	900		
Carried forward \$					

Item No.	Designation	Unit	Quantity	Unit Price	Amount
			Brought forward		\$
21	8-Inch V.C. Pipe (open joint)	lin.ft.	100		
22	10-Inch " " " "	" "	100		
23	12-Inch " " " "	" "	1,300		
24	15-Inch " " " "	" "	160		
25	18-Inch V.C. Pipe				
	a. Open Joints	" "	180		
	b. Mortar Joints	" "	310		
26	24-Inch V.C. Pipe (mortar joints)	" "	200		
27	8-Inch V.C. Pipe perforated (open joints)	" "	50		
28	30-Inch Reinforced Concrete Pipe	" "	1,570		
29	36-Inch " " "	" "	140		
30	48-Inch " " "	" "	30		
31	8-Inch Cast Iron Pipe (open joints)	" "	220		
32	12-Inch " " " " "	" "	40		
33	18-Inch " " " " "	" "	100		
34	18-Inch " " " (caulked)	" "	36		
35	30-Inch " " " "	" "	40		
36	Cement	bbl.	27,400		
37	Concrete, Class "A"	cu.yd.	11,400		
38	Concrete, Class "B"	" "	10,450		
39	Steel Reinforcement	lbs.	2,320,000		
40	Pumping Station Features	job.	--		
			Carried forward		\$

Item No.	Designation	Unit	Quantity	Unit Price	Amount
			Brought forward		\$
41	Furnishing and Installing Tailrace Gates and Accessories	lbs.	194,000		
42	Furnishing and Installing Tailrace Gate Hoists, Complete	pair	16		
43	Furnishing and Installing Sluice Gates and Hoists	each	4		
44	Furnishing and Installing Traveling Cranes, including Girders and Side Rails	"	4		
45	Miscellaneous Iron and Steel	lb.	100,000		
46	Miscellaneous Black Steel Pipe	"	7,800		
47	Copper Water Stops	"	3,700		
48	Electric Lighting System (Wiring and Fixtures)	job	--		
49	Fibre Conduit	lin.ft.	6,000		
50	Lead Covered Cable (4 sizes)				
	a. 250 M.C.M.	" "	500		
	b. 000 A.W.G.	" "	4,000		
	c. 0 A.W.G.		2,000		
	d. 6 A.W.G.		200		
51	Pull Boxes	lb.	7,800		
52	Installing Equipment Furnished by the Government	job.			
53	Installing Miscellaneous Pipe and Fittings	lin.ft.	500		
54	Installing Miscellaneous Gate Valves	each	17		
Carried forward					\$

Item No.	Designation	Unit	Quantity	Unit Price	Amount
			Brought forward		\$
55	Timber Stop-Logs	M.F.B.M.	16		
56	Topsoil on Embankment	cu.yd.	600		
57	Sodding and Seeding	acro	0.4		
58	Surfacing for Top of Dike	cu.yd.	60		
59	Surfacing for Roads	" "	100		
60	Bituminous Macadam Road Surfacing	sq.yd.	700		
TOTAL BID					

Notes: (1) All amounts and total given above will be subject to verification by the United States. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(2) All bids must be for the entire work and must have each blank space filled.

(3) The quantities of each item of the bid as finally ascertained at the close of the contract, and the unit prices of the various items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect costs connected with it.

PLANT TO BE USED ON THE WORK

(See Invitation for Bids and Paragraph 1-09 of the specifications)

Note: - Use separate line for each major item.

No.	:	Name	:	Kind	:	Capacity	:	Age and Condition
-----	---	------	---	------	---	----------	---	-------------------

Material Handling Equipment

Pumping Equipment

Earth Embankment Equipment - Rolled Fill
(Excavation and Transportation)

(Spreading and Rolling)

Rock Fill and Riprap Equipment

Gates and Accessories, Machinery

(The bidder shall submit catalogues and information showing all details of permanent equipment he proposes to install.)

Concreting Equipment

Steel Sheet Pile Driving Equipment

Miscellaneous Equipment

(Bid Form) 7

EXPERIENCE. - (See Invitation for Bids)

LIST OF PERSONNEL BY OCCUPATIONS EXPECTED TO BE EMPLOYED

(See Paragraph IX (b) of Invitation for Bids.)

Occupation	No. Expected to be Employed	Number of Months Employed
Laborer		
Teamster		
Watchman		
Fireman		
Foreman		
Carpenter's Helper		
Powderman's Helper		
Air Compressor Operator		
Crusher Operator		
Grader Operator		
Jackhammer Operator		
Pump Operator		
Tractor Operator		
Truck Operator		
Blacksmith		
Blaster or Powderman		
Carpenter		
Electrician		
Derrick Operator		
Hoist Operator		
Power Shovel Operator		
Roller Operator		

DATA SHEET

SLUICE GATES

- a. Manufacturer _____
- b. Type frame _____
- c. Frame material _____
- d. Frame seal material _____
- e. Leaf material _____
- f. Leaf seal material _____
- g. Rod material _____
- h. Rod diameter _____

DATA SHEET

HOISTS

- a. High speed gear ratio _____
- b. Low speed gear ratio _____
- c. Pedestal and gear case material _____
- d. Operating nut material _____
- e. Bevel gear material _____
- f. Bevel pinion material _____
- g. Spur gear material _____
- h. Spur pinion material _____

DATA SHEET

TRAVELING CRANE

- a. Manufacturer _____
- b. Capacity, _____ tons
- c. Bridge type _____
- d. Hoist manufacturer _____
- e. Hoist type _____
- f. Trolley manufacturer _____
- g. Trolley type _____

DATA SHEET

LEAD COVERED CABLE

Main Feeders.

1. Manufacturer _____
2. Conductor size (M.C.M.) _____
(A.W.G.) _____
3. Rated Voltage _____
4. Test Voltage _____
5. Current Capacity (100% load factor) _____
6. Operating temperature _____ (°C.)
7. Insulation:
 - a. Type _____
 - b. Thickness _____
 - c. Per cent rubber _____
8. Electrical Constants:
 - a. Resistance (ohms per M ft. per conductor) _____
 - b. Reactance (" " " " ") _____
 - c. Insulation Resistance (megohms per M ft.) _____
9. Lead Sheath
 - a. Thickness _____
 - b. Alloy Constituents (per cent) _____

DATA SHEET

LEAD COVERED CABLE

Interstation Feeders, Between Pumping Stations Nos. 1 and 2.

1. Manufacturer _____
2. Conductor Size (M.C.M.) _____
(A.W.G.) _____
3. Rated Voltage _____
4. Test Voltage _____
5. Current Capacity (100% load factor) _____
6. Operating temperature _____ (°C.)
7. Insulation:
 - a. Type _____
 - b. Thickness _____
 - c. Per cent rubber _____
8. Electrical Constants:
 - a. Resistance (ohms per M ft. per conductor) _____
 - b. Reactance (" " " " ") _____
 - c. Insulation Resistance (megohms per M ft.) _____
9. Lead Sheath:
 - a. Thickness _____
 - b. Alloy Constituents (per cent) _____

DATA SHEET

LEAD COVERED CABLE

Interstation Feeders, Between Pumping Stations Nos. 3 and 4.

1. Manufacturer _____
2. Conductor Size (M.C.M.) _____
(A.W.G.) _____
3. Rated Voltage _____
4. Test Voltage _____
5. Current Capacity (100% load factor) _____
6. Operating temperature _____ (°C.)
7. Insulation:
 - a. Type _____
 - b. Thickness _____
 - c. Per cent rubber _____
8. Electrical Constants:
 - a. Resistance (ohms per M ft. per conductor) _____
 - b. Reactance (" " " " ") _____
 - c. Insulation Resistance (megohms per M ft.) _____
9. Lead Sheath:
 - a. Thickness _____
 - b. Alloy Constituents (per cent) _____

DATA SHEET

LEAD COVERED CABLE

Motor Feeders.

1. Manufacturer _____
2. Conductor Size (M.C.M.) _____
(A.W.G.) _____
3. Rated Voltage _____
4. Test Voltage _____
5. Current Capacity (100% load factor) _____
6. Operating temperature _____ (°C.)
7. Insulation:
 - a. Type _____
 - b. Thickness _____
 - c. Per cent rubber _____
8. Electrical Constants:
 - a. Resistance (ohms per M ft. per conductor) _____
 - b. Reactance (" " " " ") _____
 - c. Insulation Resistance (megohms per M ft.) _____
9. Lead Sheath:
 - a. Thickness _____
 - b. Alloy Constituents (per cent) _____

It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials and supplies as have been mined or produced in the United States and only such manufactured articles, materials, and supplies as have been manufactured in the United States all from articles, materials, or supplies mined, produced or manufactured, as the case may be, in the United States, except as noted below or otherwise indicated in his bid or authorized in the specifications.

The undersigned agrees, upon receipt of written notice of the acceptance of this bid within 60 days after the date of opening of the bids, to execute the standard form of Government contract, in accordance with the bid as accepted, and to give the required performance and payment bonds, with good and sufficient surety or sureties for the faithful performance of the contract and for the protection of all persons supplying labor and materials in the prosecution of the work, within 10 days after the prescribed forms are presented for signature.

Performance will begin within 10 calendar days after the date of receipt of notice to proceed and will be completed within 450 calendar days after date of receipt of said notice to proceed.

(Bidder)

(Address)

By _____
(Name) (Title)

NOTE:-- Read Standard Government Instructions to Bidders before preparing this bid.